# APPENDIX F

## F. National Vegetation Classification (NVC) Local and Global Descriptions for Wupatki National Monument

(Kathryn Thomas and Monica Hansen of the USGS Colorado Plateau Research Station collected, analyzed, and initially classified field relevé data. Marion Reid and Keith Schulz of NatureServe reviewed and finalized local classification and compiled global classification.)

The following vegetation descriptions are derived from the 214 vegetation relevés sampled throughout the course of this project. Global information, information based on reports throughout the distribution of the associations/alliances, was also compiled by NatureServe to augment the local descriptions. All of the vegetation association descriptions will include information on both the global and local descriptions, unless the associations have only been described from Wupatki National Monument.

Each description is separated into twelve sections. Many of the sections are subdivided into a 'Wupatki National Monument' and a 'Globally' subsection. After the Wupatki National Monument subheading, information follows on the association/alliance as it appears in the park, the local information. After the Globally subheading information follows on the association/alliance as it appears throughout its range. Information about each of the sections is described in Table 1. References for all the vegetation descriptions are located at the end of Appendix F.

**Table 1. Explanations on the vegetation descriptions sections.**

| **Vegetation Description Sections** | **Explanation** |
|---|---|
| Classification Confidence Level | The classification confidence level identified by NatureServe. |
| USFS Wetland System | The U.S. Dept. of Agriculture – Forest Service (USDA – FS) wetland classification system ranking crosswalked to NVC associations, provided by NatureServe. |
| Range | The range describes where this association was mapped in the project area, information on where particular relevés were sampled, and where the association occurs throughout its entire range. |
| Environmental Description | Environmental description describes the abiotic conditions measured related to the association/alliance. In the local descriptions, all slopes are described as a range of elevation (lowest to highest elevation) as well as an average elevation across all of the relevés measured in feet (ft) and meters (m). |
| Most Abundant Species | This section identifies the dominant and/or indicator species for Wupatki National Monument and globally throughout its range. |
| Associated Species | Associated species describes the most common species associated with all of the relevés locally and globally. |
| Vegetation Description | This section identifies the vegetation characteristics specific to the association/alliance. Locally, total vegetation cover is described as absolute percent cover and is given as a range (lowest to highest % cover) and average across all of the relevés. |
| Conservation Rank | The conservation rank is a ranking system used to identify and prioritize conservation areas applied to NVC associations by NatureServe. The global conservation rank is described in the Table 2. See NatureServe Explorer for further documentation of NaturServe's ranking system |

| | |
|---|---|
| | (http://www.natureserve.org/explorer/). |
| Database Code | Database codes are a unique code that NatureServe developed to organize and identify the vegetation associations. |
| Map Classes | Map classes describes how the association is crosswalked to the map class, a general description of where the map class occurs, and the total number of acres (ac)/hectares (ha) and polygons occurring inside and outside Wupatki National Monument. |
| Comments | Comments particular to the vegetation description locally at Wupatki National Monument and globally. |
| References | References that relate to the association. The entire citation is listed at the end of Appendix F. |

**Table 2. Conservation ranking system for associations.**

| **Global Conservation Rank** |
|---|
| GX – Eliminated |
| GH – Presumed eliminated (historic) |
| G1 – Critically imperiled |
| G2 – Imperiled |
| G3 – Vulnerable |
| G4 – Apparently secure |
| G5 – Secure |
| GU – Unrankable |
| G? – Unranked |

**List of vegetation community types (NVC Associations) organized by NVC structure**.

# *Atriplex obovata* Badland Sparse Vegetation

| | |
|---|---|
| MAP CLASS | Mound Saltbush Badlands Sparse Vegetation |
| COMMON NAME | Mound Saltbush Badland Sparse Vegetation |
| PHYSIOGNOMIC CLASS | Sparse Vegetation (VII) |
| PHYSIOGNOMIC SUBCLASS | Unconsolidated material sparse vegetation (VII.C) |
| PHYSIOGNOMIC GROUP | Sparsely vegetated soil slopes (VII.C.3) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (VII.C.3.N.) |
| FORMATION | Dry slopes (VII.C.3.N.b) |
| ALLIANCE | Painted Desert Sparsely Vegetated Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE
**Wupatki National Monument**
Mound Saltbush Badland Sparse Vegetation is a uncommon association within Wupatki NM. Of the six relevés sampled, it was mainly located in the environs in sparse badland habitats on the Navajo Nation on the eastern section of the mapping area.

ENVIRONMENTAL DESCRIPTION
**Wupatki National Monument**
This association's elevation ranged from 4,265-4,495 ft (1,300-1,370 m) (average 4,331 ft/1,320 m). The topography consisted of flat areas with 0-10% slope (average 3%). The substrate in the badlands included clay, sandstone, and pebble plains.

MOST ABUNDANT SPECIES
**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Atriplex obovata* |
| Herbaceous | *Salsola tragus* |

ASSOCIATED SPECIES
**Wupatki National Monument**
*Atriplex canescens, Opuntia macrorhiza, Sphaeralcea hastulata, Sporobolus airoides*

VEGETATION DESCRIPTION
**Wupatki National Monument**
Mound Saltbush Badland Sparse Vegetation total vegetation cover was 3-23% (average 11%) with 2-16% (average 6%) in the shrub layer and 1-9% (average 5%) in the herbaceous layer. The total species diversity was low and ranged from 4-7 species (average 6) within the 6 relevés sampled.

The vegetation was dominated by *Atriplex obovata* in the shrub layer with 0.5-17% absolute cover (average 5%) or *Salsola tragus* in the herbaceous layer with 0.5-7% absolute cover (average 5%). As this is a sparse type, total cover was generally less than 15%. The invasive non-native annual *Salsola tragus* can vary in percent cover, and may occur with higher cover than *Atriplex obovata*. Both *Atriplex obovata* and *Salsola tragus* must both be present, even in trace amounts, to be classified in this association.

CONSERVATION RANK G?

DATABASE CODE CEGL002928

MAP CLASSES

The association Mound Saltbush Badland Sparse Vegetation is represented by map class Mound Saltbush Badlands Sparse Vegetation (map code 4).

The Mound Saltbush Badlands Sparse Vegetation was mapped only in the project environs. The total area in the park environs is 3,304 ac (1,337 ha) within 29 map classes.

COMMENTS

**Wupatki National Monument**

*Salsola tragus* is a non-native annual species that is adventitious from Asia (Welsh et al. 1987). This species is widespread in North America and thrives in disturbed habitats (Welsh et al. 1987). The dominance of *Salsola tragus* in the association Mound Saltbush Badland Sparse Vegetation may result from the degree of human disturbance within this sparsely vegetated association.

## *Ephedra torreyana – (Atriplex canescens, confertifolia)* Sparse Vegetation

| | |
|---|---|
| MAP CLASS | Moenkopi Shale Sparse Vegetation |
| COMMON NAME | Torrey's Joint-fir – (Fourwing Saltbush, Shadscale) Sparse Vegetation |
| PHYSIOGNOMIC CLASS | Sparse Vegetation (VII) |
| PHYSIOGNOMIC SUBCLASS | Unconsolidated material sparse vegetation (VII.C) |
| PHYSIOGNOMIC GROUP | Sparsely vegetated soil slopes (VII.C.3) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (VII.C.3.N) |
| FORMATION | Dry slopes (VII.C.3.N.b) |
| ALLIANCE | *Ephedra torreyana* Sparsely Vegetated Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE
**Wupatki National Monument**
Torrey's Joint-fir – (Fourwing Saltbush, Shadscale) Sparse Vegetation is one of the most common associations on the sparse badlands. Our six relevés sampled were located in the eastern section of the project boundary in Wupatki NM, Babbitt Ranches, and Navajo Nation lands.

ENVIRONMENTAL DESCRIPTION
**Wupatki National Monument**
This association's elevation ranged from 4,298-4,524 ft (1,310-1,379 m) (average 4,380 ft/1,335 m). The topography ranged from level areas to hills with slopes ranging from 0-45% (average 9%). It is located within sparse badland habitats with substrate including clay soils, riverine cobbles, basaltic cobbles, and sandstone bluffs.

MOST ABUNDANT SPECIES
**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Ephedra torreyana, Atriplex canescens, Atriplex confertifolia* |

ASSOCIATED SPECIES
**Wupatki National Monument**
*Achnatherum hymenoides, Artemisia filifolia, Bouteloua eriopoda, Dasyochloa pulchella, Ephedra viridis, Eriogonum corymbosum, Ericameria nauseosa, Fallugia paradoxa, Gutierrezia sarothrae, Muhlenbergia porteri, Pleuraphis jamesii, Psorothamnus thompsoniae, Salsola tragus, Sphaeralcea* sp., *Sporobolus airoides, Stanleya pinnata, Tiquilia latior, Yucca angustissima*

VEGETATION DESCRIPTION
**Wupatki National Monument**
Torrey's Joint-fir – (Fourwing Saltbush, Shadscale) Sparse Vegetation total vegetation cover was 6-17% (average 10%) with 4-12% (average 8%) in the shrub layer and 0.5-7% (average 3%) in the herbaceous layer. The total species diversity was low and ranged from 4-16 species (average 10) within the 6 relevés sampled.

*Ephedra torreyana* is an indicator for this association and must be present for the association definition. It was found with 0.5-7% absolute cover (average 4%). *Atriplex canescens* or *Atriplex confertifolia* may be dominant in this association, if *Ephedra torreyana* has low cover, but either do not have to be present. *Atriplex canescens* ranged from 0-5% absolute cover (average 1%) and *Atriplex confertifolia* ranged from 0-5% absolute cover (average 1%). The herbaceous layer was not dominated a single species.

CONSERVATION RANK G?

DATABASE CODE CEGL005801

MAP CLASSES
The association Torrey's Joint-fir – (Fourwing Saltbush, Shadscale) Sparse Vegetation is represented by map class Moenkopi Shale Sparse Vegetation (map code 6).

The total area mapped within Wupatki NM is 5,014 ac (2,029 ha) within 274 polygons and the total area in the park environs is 6,415 ac (2,596 ha) within 125 polygons.

The map class Moenkopi Shale Sparse Vegetation was used to map all sparsely vegetated Moenkopi shale badland associations. *Ephedra torreyana* was used an indicator for this map class, however it does not have to be dominant in the sparsely vegetated badland habitats to be mapped within this map class.

## *Eriogonum corymbosum* Cinder Sparse Vegetation

| | |
|---|---|
| MAP CLASS | Crispleaf Buckwheat Cinder Shrubland |
| COMMON NAME | Crispleaf Buckwheat Cinder Sparse Vegetation |
| PHYSIOGNOMIC CLASS | Sparse Vegetation (VII) |
| PHYSIOGNOMIC SUBCLASS | Unconsolidated material sparse vegetation (VII.C) |
| PHYSIOGNOMIC GROUP | Sparsely vegetated soil slopes (VII.C.3) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (VII.C.3.N) |
| FORMATION | Dry slopes |
| ALLIANCE | *Eriogonum corymbosum* Sparsely Vegetated Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE
**Wupatki National Monument**
Crispleaf Buckwheat Cinder Sparse Vegetation is an uncommon association within Wupatki NM that occurs in sparse cinder habitats. This association was only located in the southwestern corner of Wupatki NM and was not found in other areas within the project boundaries.

ENVIRONMENTAL DESCRIPTION
**Wupatki National Monument**
This association's elevation ranged from 4,856-5,020 ft (1,480-1,530 m) (average 4,970 ft/1,515 m). The topography ranged from minimal to steep slopes with 3-40% slope (average 24%). This association is specifically located within sparse community types on black cinder dominated substrate.

MOST ABUNDANT SPECIES
**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Eriogonum corymbosum* |

ASSOCIATED SPECIES
**Wupatki National Monument**
*Achnatherum hymenoides, Aristida purpurea, Artemisia filifolia, Brickellia californica, Ephedra torreyana, Ephedra viridis, Ericameria nauseosa, Fallugia paradoxa, Hesperostipa comata, Muhlenbergia porteri, Oenothera pallida, Stanleya pinnata*

VEGETATION DESCRIPTION
**Wupatki National Monument**
Crispleaf Buckwheat Cinder Sparse Vegetation total vegetation cover was low with 11-25% (average 15%) with 6-25% (average 13%) in the shrub layer and 0-11% (average 3%) in the herbaceous layer. The total species diversity was low and ranged from 3-9 species (average 6) within the 8 relevés sampled.

The shrub layer consistently contains *Eriogonum corymbosum* with 2-15% absolute cover (average 8%). *Eriogonum corymbosum* must be present for assignment of this association type; however, other shrubs such as *Brickellia californica* and *Fallugia paradoxa* may be present in greater abundance. The herbaceous layer was sparse and not dominated by a single species.

CONSERVATION RANK G?

DATABASE CODE CEGL005803

MAP CLASSES

The association Crispleaf Buckwheat Cinder Sparse Vegetation is represented by map class Crispleaf Buckwheat Cinder Shrubland (map code 15).

The total area mapped within Wupatki NM is 203 ac (82 ha) within 14 polygons. The total for the project environs is 151 ac (61 ha) within 37 polygons.

## *Atriplex canescens – (Ephedra viridis) / (Muhlenbergia porteri*) Sandstone Sparse Vegetation [Provisional]

| | |
|---|---|
| MAP CLASS | Moenkopi Sandstone Sparse Vegetation |
| COMMON NAME | Fourwing Saltbush – (Mormon Tea) / (Bush Muhly) Sandstone Sparse Vegetation |
| PHYSIOGNOMIC CLASS | Sparse Vegetation (VII) |
| PHYSIOGNOMIC SUBCLASS | Boulder, gravel, cobble, or talus sparse vegetation (VII.B) |
| PHYSIOGNOMIC GROUP | Sparsely vegetated rock flats (VII.B.2) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (VII.B.2.N) |
| FORMATION | Boulder fields (VII.B.2.N.a) |
| ALLIANCE | Sandstone Sparsely Vegetated Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE

**Wupatki National Monument**

Fourwing Saltbush – (Mormon Tea) / (Bush Muhly) Sandstone Sparse Vegetation is the most common association in the sandstone sparse communities. This association was found in seven relevés sampled at Wupatki NM in the eastern half of the park. No relevés were sampled outside of Wupatki NM; however, this may be due to low numbers of relevés sampling outside of the national monument boundaries. Additional sampling outside the national monument boundaries may reveal more occurrences.

ENVIRONMENTAL DESCRIPTION

**Wupatki National Monument**

This association's elevation ranged from 4,396-4,856 ft (1,340-1,480 m) (average 4,741ft/1,445 m). The topography ranged from small to steep slopes with 0-25% slope (average 14%). This association is specific to sandstone soils including bluffs, boulders, and shards.

MOST ABUNDANT SPECIES

**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Atriplex canescens, Ephedra viridis* |
| Herbaceous | *Muhlenbergia porteri* |

ASSOCIATED SPECIES

**Wupatki National Monument**

*Artemisia bigelovii, Artemisia dracunculus, Artemisia filifolia, Bouteloua curtipendula, Dasyochloa pulchella, Ephedra torreyana, Gutierrezia sarothrae, Isocoma drummondii, Pleuraphis jamesii, Rhus trilobata, Salsola tragus, Sporobolus airoides, Sporobolus flexuosus, Sphaeralcea hastulata, Stanleya pinnata*

VEGETATION DESCRIPTION

**Wupatki National Monument**

Fourwing Saltbush – (Mormon Tea) / (Bush Muhly) Sandstone Sparse Vegetation total vegetation cover is 5-16% (average 11%) with 4-15% (average 9%) in the shrub layer and 1-6% (average 3%) in the herbaceous layer. The total species diversity ranged from 12-17 species (average 15) in the 7 relevés sampled.

The shrub layer was dominated by *Atriplex canescens* with 1-6% absolute cover (average 3%) and sometimes *Ephedra viridis* with 0-4% absolute cover (average 2%). The herbaceous layer could be dominated by *Muhlenbergia porteri* with absolute cover 0-4% (average 1%). *Atriplex canescens* must be present in this association, even with low percent cover. *Ephedra viridis* and *Muhlenbergia porteri* are often present; however, they do not necessarily need to be present within this sparse vegetation type.

CONSERVATION RANK G?

DATABASE CODE CEGL002927

MAP CLASSES
The association Fourwing Saltbush – (Mormon Tea) / (Bush Muhly) Sandstone Sparse Vegetation is represented by map class Moenkopi Sandstone Sparse Vegetation (map code 5).

The total area mapped within Wupatki NM is 1,811 ac (733 ha) within 543 polygons and the total area in the park environs is 717 ac (290 ha) within 146 polygons.

The map class Moenkopi Sandstone Sparse Shrubland was used to map all sparsely vegetated sandstone outcrops and soils. *Atriplex canescens*, used as an indicator for this association, does not necessarily have to be present for vegetation to be classified as this map class. Other vegetation types have been measured on the sandstone in the project boundaries, but have not been described as separate associations. For instance, the photointerpreters noticed that in some areas *Gutierrezia sarothrae* and *Rhus trilobata* were the dominant species within these sandstone sparse communities, without *Atriplex canescens* present. These areas were also included in the Moenkopi Sandstone Sparse Vegetation map class.

COMMENTS
**Wupatki National Monument**
Review of additional plot data on sandstone may reveal additional associations within the Sandstone Sparse Vegetation Alliance.

## *Andropogon hallii* Colorado Plateau Herbaceous Vegetation

| | |
|---|---|
| MAP CLASS | Sand Bluestem Grassland |
| COMMON NAME | Sand Bluestem Colorado Plateau Herbaceous Vegetation |
| PHYSIOGNOMIC CLASS | Herbaceous Vegetation (V.) |
| PHYSIOGNOMIC SUBCLASS | Perennial graminoid vegetation (V.A.) |
| PHYSIOGNOMIC GROUP | Temperate or subpolar grassland (V.A.5.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (V.A.5.N.) |
| FORMATION | Tall sod temperate grassland (V.A.5.N.a.) |
| ALLIANCE | *Andropogon hallii* Herbaceous Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE
**Wupatki National Monument**
Sand Bluestem Colorado Plateau Herbaceous Vegetation is an uncommon association within Wupatki NM. This association was identified from only one relevé on top of Woodhouse Mesa adjacent to the Visitor Center at Wupatki NM. This association may occur as small patches in other areas within the park; however, these areas were not sampled or may be below the minimum mapping unit.

ENVIRONMENTAL DESCRIPTION
**Wupatki National Monument**
This association's elevation was recorded at 5,151 ft/1,570 m on a level basaltic outcrop.

MOST ABUNDANT SPECIES
**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Herbaceous | *Andropogon hallii* |

ASSOCIATED SPECIES
**Wupatki National Monument**
*Ephedra torreyana, Fallugia paradoxa, Hesperostipa comata, Ericameria nauseosa, Pleuraphis jamesii (*all occur with >1% cover)

VEGETATION DESCRIPTION
**Wupatki National Monument**
Sand Bluestem Colorado Plateau Herbaceous Vegetation total vegetation cover was 40%, with 8% in the shrub layer and 36% in the herbaceous layer. Within the one relevé sampled the total species diversity was 12.

The shrub layer was not dominated by a single species. In the herbaceous layer *Andropogon hallii* dominated with 23% absolute cover.

CONSERVATION RANK G?

DATABASE CODE CEGL002785

MAP CLASSES
The association Sand Bluestem Colorado Plateau Herbaceous Vegetation was mapped when located in the field as a park special represented by Sand Bluestem Grassland (map code 7). However, due to this association occurring in low frequency and with a difficult photosignature to distinguish, this association type often mapped as an inclusion in the map class Galleta Mixed Grasslands.

The total area of the park special Sand Bluestem Grassland in Wupatki NM is 9 ac (4 ha) within 5 polygons. The total area of Sand Bluestem in the project environs is 3 ac (1 ha) within 4 polygons.

COMMENTS

**Wupatki National Monument**

This association may have a patchy distribution within Wupatki NM; a more extensive survey is needed in order to understand the distribution of this vegetation association.

## *Bouteloua eriopoda – Pleuraphis jamesii* Herbaceous Vegetation

| | |
|---|---|
| MAP CLASS | Galleta Mixed Grasslands |
| COMMON NAME | Black Grama – Galleta Herbaceous Vegetation |
| PHYSIOGNOMIC CLASS | Herbaceous Vegetation (V.) |
| PHYSIOGNOMIC SUBCLASS | Perennial graminoid vegetation (V.A.) |
| PHYSIOGNOMIC GROUP | Temperate or subpolar grassland (V.A.5.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (V.A.5.N.) |
| FORMATION | Short sod temperate or subpolar grassland (V.A.5.N.e.) |
| ALLIANCE | *Bouteloua eriopoda* Herbaceous Alliance |

CLASSIFICATION CONFIDENCE LEVEL Moderate

USFS WETLAND SYSTEM Upland

RANGE

**Wupatki National Monument**

Black Grama – Galleta Herbaceous Vegetation was only identified from the classification relevés in the project environs outside of Wupatki NM, north of Wupatki Ruins. It was found in the environs on the Babbitt Ranches land, north of the National Monument, near the Babbitt ranch houses, and west of Highway 89 between the water tank and the power line.

**Globally**

This Colorado Plateau association is known from the upper Rio Puerco watershed in northwestern New Mexico and Wupatki National Monument in north-central Arizona. It may extend south to the Chihuahuan Desert.

ENVIRONMENTAL DESCRIPTION

**Wupatki National Monument**

This association's elevation ranged from 4,774-5,643 ft (1,455-1,720 m) (average 5,249 ft/1,600 m). It was found on basaltic soils and intermixed sandstone with low slope ranging from 0-4% (average 1%).

**Globally**

This Colorado Plateau desert grassland has been documented from the upper Rio Puerco watershed in northwestern New Mexico and in north-central Arizona. Elevations range from 4,770-6,000 ft (1,455-1,830 m). Stands occur on flat to gently sloping plains, basin floors, and mesas. Substrates are variable and include weakly developed Entisols and Entisol-Mollisol complexes often with loam to clay-loam textured soils derived from basalt outcrop, clay and sandstone; and coarser-textured soils derived from black cinders and sandstone (Francis 1986).

MOST ABUNDANT SPECIES

**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Herbaceous | *Pleuraphis jamesii, Bouteloua eriopoda* |

**Globally**

| Stratum | Species |
|---|---|
| Dwarf-Shrub | *Gutierrezia sarothrae* |
| Herbaceous | *Pleuraphis jamesii, Bouteloua eriopoda* |

ASSOCIATED SPECIES

**Wupatki National Monument**

*Ephedra torreyana, Gutierrezia sarothrae, Hesperostipa comata, Muhlenbergia porteri, Sporobolus airoides*

**Globally**

*Atriplex canescens Ephedra torreyana, Ericameria nauseosa, Gutierrezia sarothrae, Aristida purpurea*, *Bouteloua gracilis*, *Hesperostipa neomexicana, Muhlenbergia porteri*, *Sporobolus airoides* and *Sporobolus cryptandrus*

VEGETATION DESCRIPTION

**Wupatki National Monument**

Black Grama – Galleta Herbaceous Vegetation total vegetation cover ranges from 24-39% (average 36%) with 0.5-5% (average 2%) in the shrub layer and 21-40% (average 35%) in the herbaceous layer. The total species diversity ranged from 5-17 species (average 10) within the 3 relevés sampled.

The shrub layer was not dominated by a single species. The herbaceous layer was co-dominated by *Pleuraphis jamesii* with 12-24% absolute cover (average 19%) and *Bouteloua eriopoda* with 5-17% absolute cover (average 11%). *Bouteloua eriopoda* is an indicator in this association, with *Pleuraphis jamesii* having up to two times greater cover than *Bouteloua eriopoda.*

**Globally**

This association is characterized by *Bouteloua eriopoda* and *Pleuraphis jamesii (= Hilaria jamesii)* codominating an open to moderately dense perennial graminoid layer. Associates include low cover of *Aristida purpurea*, *Bouteloua gracilis*, *Hesperostipa neomexicana (= Stipa neomexicana), Muhlenbergia porteri*, *Sporobolus airoides* and *Sporobolus cryptandrus*. Forb cover and diversity is low. Scattered shrubs and dwarf-shrub may be present including *Atriplex canescens, Ephedra torreyana, Ericameria nauseosa* and *Gutierrezia sarothrae* (Francis 1986). The presence of *Bouteloua eriopoda* and *Muhlenbergia porteri* suggests that this grassland is transitional to Chihuahuan Desert grasslands that begin over 100 miles to the south.

CONSERVATION RANK G3

DATABASE CODE CEGL001751

MAP CLASSES

The association Black Grama – Galleta Herbaceous Vegetation is represented by map class Galleta Mixed Grasslands (map code 11).

The total area mapped of this combined map class within Wupatki NM is 7,270 ac (2,942 ha) within 374 polygons and the total area in the park environs is 22,025 ac (8,913 ha) within 427 polygons.

This association's photosignature is indistinguishable from other mixed galleta grassland types; therefore this association type was not mapped as a unique vegetation association and was combined into a Galleta Mixed Grassland map class. The map class Galleta Mixed Grasslands consists of *Pleuraphis jamesii- Sporobolus airoides* Herbaceous Vegetation and *Bouteloua eriopoda - Pleuraphis jamesii* Herbaceous Vegetation.

COMMENTS

**Globally**

Limited quantitative documentation exists for this type.

REFERENCES

Bourgeron and Engelking 1994, Driscoll et al. 1984, Francis 1986

## *Bouteloua eriopoda* Coconino Plateau Shrub Herbaceous Vegetation

| | |
|---|---|
| MAP CLASS | Black Grama Coconino Plateau Mixed Shrubland, Black Grama Grassland |
| COMMON NAME | Black Grama Coconino Plateau Shrub Herbaceous Vegetation |
| PHYSIOGNOMIC CLASS | Herbaceous Vegetation (V) |
| PHYSIOGNOMIC SUBCLASS | Perennial graminoid vegetation (V.A) |
| PHYSIOGNOMIC GROUP | Temperate or subpolar grassland with a sparse shrub layer (V.A.7) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (V.A.7.N) |
| FORMATION | Short temperate or subpolar grassland with sparse xeromorphic (evergreen and/or deciduous) shrub layer (V.A.7.N.m) |
| ALLIANCE | *Bouteloua eriopoda* Xeromorphic Shrub Herbaceous Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE
**Wupatki National Monument**
Black Grama Coconino Plateau Shrub Herbaceous Vegetation is a common association in Wupatki NM and its environs. This association was found in twenty-one of our relevés at the northern half of Wupatki NM, specifically north of Crack-in-rock Road in Antelope Wash and on White Mesa. It also was found to occur on Babbitt Ranches land on White Mesa as well as west of Highway 89.

ENVIRONMENTAL DESCRIPTION
**Wupatki National Monument**
This association's elevation ranged from 4,757-5,807 ft (1,450-1,770 m) (average 5,167 ft/1,575 m). The substrate consisted mainly of limestone cobbles, gravel, and bedrock with black cinders and clay loam soils. A few of the relevés also were characterized by sand and sandstone. The slope varied from gentle to steep, 0-20% (average 6%).

MOST ABUNDANT SPECIES
**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | Mixed shrubs including: *Atriplex confertifolia, Atriplex canescens, Ephedra viridis, Ericameria nauseosa, Gutierrezia sarothrae* |
| Herbaceous | *Bouteloua eriopoda* |

ASSOCIATED SPECIES
**Wupatki National Monument**
*Aristida purpurea var. longiseta, Brickellia oblongifolia, Ephedra cutleri, Ephedra torreyana, Fallugia paradoxa, Juniperus monosperma, Hesperostipa comata, Lycium andersonii, Muhlenbergia porteri, Opuntia whipplei, Pleuraphis jamesii, Sphaeralcea parvifolia, Sporobolus airoides, Sporobolus contractus*

VEGETATION DESCRIPTION
**Wupatki National Monument**
Black Grama Coconino Plateau Shrub Herbaceous Vegetation total vegetation cover ranges from 21-46% (average 34%) with 1-24% (average 11%) in the shrub layer and 15-43% (average 24%) in the herbaceous layer. The total species diversity ranged from 4-16 species (average 10) in the 21 relevés sampled.

The shrub layer was not dominated by a single species; rather, several species of Colorado Plateau characteristic shrubs can dominate or co-dominate in the shrub canopy depending on abiotic factors and land use history. These shrubs include *Atriplex confertifolia* with 0-10% absolute cover (average 1%), *Atriplex canescens* with absolute cover 0-4% (average 1%), *Ephedra viridis* with absolute cover 0-6% (average 2%), *Ericameria nauseosa* with absolute cover 0-24% (average 4%), and *Gutierrezia sarothrae* with absolute cover 0-17% (average 3%). The herbaceous layer was dominated by *Bouteloua eriopoda* with 8-42% absolute cover (average 18%).

CONSERVATION RANK G?

DATABASE CODE CEGL002787

MAP CLASSES
The association Black Grama Coconino Plateau Shrub Herbaceous Vegetation is represented by map class Black Grama Coconino Plateau Mixed Shrubland (map code 16) and Black Grama Grassland (map code 8).

The association Black Grama Coconino Plateau Shrub Herbaceous Vegetation was separated into two different map classes. The map class Black Grama / Coconino Plateau Mixed Shrubland represents areas that have a high cover of *Ericameria nauseosa,* due to its consistent photosignature. However, other shrubs that had a less consistent photosignature were lumped within the Black Grama Grassland map class.

The total area mapped of these combined map classes within Wupatki NM is 3,096 ac (1,253 ha) within 224 polygons and the total area in the park environs is 3,944 ac (1,596 ha) within 189 polygons.

COMMENTS
**Wupatki National Monument**
*Bouteloua eriopoda* is the most characteristic species within this association, and must be present in order for the association definition. A steppe structure also must be present in order to be placed within this association; however, the shrub canopy can range from sparse to high densities and a variety of species can occur as well.

**Note:**
This association is found in two different map classes:
1) Black Grama Grassland
2) Black Grama Coconino Plateau Mixed Shrubland

## *Hesperostipa comata – (Bouteloua eriopoda – Pleuraphis jamesii)* Herbaceous Vegetation

| | |
|---|---|
| MAP CLASS | Needle-and-Thread Grassland |
| COMMON NAME | Needle-and-Thread – (Black Grama – Galleta) Herbaceous Vegetation |
| PHYSIOGNOMIC CLASS | Herbaceous Vegetation (V) |
| PHYSIOGNOMIC SUBCLASS | Perennial graminoid vegetation (V.A) |
| PHYSIOGNOMIC GROUP | Temperate or subpolar grassland (V.A.5) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural Temperate (V.A.5.N) |
| FORMATION | Medium-tall bunch temperate or subpolar grassland (V.A.5.N.d) |
| ALLIANCE | *Hesperostipa comata* Bunch Herbaceous Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE
**Wupatki National Monument**
Needle-and-Thread – (Black Grama – Galleta) Herbaceous Vegetation is a common association in Wupatki NM and in the environs. This association was located from our relevé data mainly in the northwestern half of Wupatki NM. It specifically occurred in Woodhouse Mesa, Antelope Prairie, and White Mesa. It also occurred on the Babbitt Ranches land on North Mesa in Antelope Prairie, West Mesa, and near the western boundary of Wupatki NM.

ENVIRONMENTAL DESCRIPTION
**Wupatki National Monument**
This association's elevation ranged from 5,118-5,545 ft (1,560-1,690 m) (average 5,364 ft/1,635 m). The substrate always consisted of a black cinder component, with intermixed basaltic cobbles, lava flow, clay, and limestone soils. The slope was often flat; however, it ranged from 0-25% (average 5%).

MOST ABUNDANT SPECIES
**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Herbaceous | *Bouteloua eriopoda, Hesperostipa comata, Pleuraphis jamesii* |

ASSOCIATED SPECIES
**Wupatki National Monument**
*Achnatherum hymenoides, Aristida purpurea var. longiseta, Artemisia filifolia, Atriplex canescens, Bouteloua curtipendula, Bouteloua gracilis, Chaetopappa ericoides, Ephedra viridis, Ericameria nauseosa, Fallugia paradoxa, Gutierrezia sarothrae, Juniperus monosperma, Krascheninnikovia lanata, Muhlenbergia porteri, Psilostrophe sparsiflora, Sporobolus airoides, Sporobolus contractus*

VEGETATION DESCRIPTION
**Wupatki National Monument**
Needle-and-Thread – (Black Grama – Galleta) Herbaceous Vegetation total vegetation cover ranges from 25-60% (average 44%) with 0-20% (average 6%) in the shrub layer and 22-52% (average 38%) in the herbaceous layer. The total species diversity ranged from 5-17 species (average 10) within the 21 relevés sampled.

The shrub layer was not dominated by a single species; however, *Ericameria nauseosa* was present in 18 of the 21 relevés with absolute cover ranging from 0-14% (average 3%). *Hesperostipa comata* was an indicator in the herbaceous class with absolute cover of 8-40% (average 18%). *Bouteloua eriopoda* and *Pleuraphis jamesii* both frequently occur within this association, but do not need to be present. *Bouteloua eriopoda* ranged from 0-27% absolute cover (average 8%) and *Pleuraphis jamesii* ranged from 0-23% absolute cover (average 11%).

CONSERVATION RANK G?

DATABASE CODE CEGL002997

MAP CLASSES

The association Needle-and-Thread – (Black Grama – Galleta) Herbaceous Vegetation is represented by map classes Needle-and-Thread Grassland (map code 9).

Needle-and-Thread – (Black Grama – Galleta) Herbaceous Vegetation was difficult to distinguish because of the potential for mixed grass species dominance. Therefore, this association was only mapped as a Needle-and-Thread Grassland with stands of relatively pure ($\geq$ 50%) Needle-and-Thread Grass. Stands of mixed Needle-and-Thread and Galleta were mapped as Mixed Galleta Grassland and stands of mixed Needle-and-Thread and Black Grama were classified as Black Grama Grassland.

The total area mapped of Needle-and-Thread Grassland within Wupatki NM is 729 ac (295 ha) within 44 polygons and the total area in the park environs is 830 ac (336 ha) within 77 polygons.

COMMENTS

**Wupatki National Monument**

*Hesperostipa comata* is the diagnostic species in this association; however, it is not always the most dominant species in the association. In relevés where *Hesperostipa comata* is the dominant grass of the association, the photosignature of this type is often indistinguishable from pure stands of *Bouteloua eriopoda* or *Pleuraphis jamesii*.

## *Juniperus monosperma* Cinder Wooded Herbaceous Vegetation

| | |
|---|---|
| MAP CLASS | Oneseed Juniper Woodland |
| COMMON NAME | One-seed Juniper Cinder Wooded Herbaceous Vegetation |
| PHYSIOGNOMIC CLASS | Herbaceous Vegetation (V) |
| PHYSIOGNOMIC SUBCLASS | Perennial graminoid vegetation (V.A) |
| PHYSIOGNOMIC GROUP | Temperate or subpolar grassland with a sparse tree layer (V.A.6) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (V.A.6.N) |
| FORMATION | Medium-tall temperate or subpolar grassland with a sparse needle-leaved evergreen or mixed tree layer (V.A.6.N.f) |
| ALLIANCE | *Juniperus monosperma* Wooded Herbaceous Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE
**Wupatki National Monument**
One-seed Juniper Cinder Wooded Herbaceous Vegetation is the most common association on the USDA-FS lands in the project environs. This association from our relevé data was found to predominates the southwestern section of the project boundary including Antelope Prairie and adjacent lands surrounding Hulls Wash and Ball Court Wash. Within Wupatki NM it was found adjacent to the USDA-FS lands in Antelope Prairie.

ENVIRONMENTAL DESCRIPTION
**Wupatki National Monument**
This association's elevation ranged from 5,364-5,758 ft (1,635-1,755 m) (average 5,512 ft/1,680 m). The slope was minimal to flat ranging from 0-5% (average 0.5%). The substrate always consisted of black cinder, with sporadic occurrence of basaltic boulders and sandstone. The cinder depth was site specific and varied depending on the geologic history of the site. Some sites had a thin layer of surface cinders and others had more than 2 m (7 ft) cinder depth.

MOST ABUNDANT SPECIES
**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Juniperus monosperma* |

ASSOCIATED SPECIES
**Wupatki National Monument**
*Aristida purpurea* var. *longiseta, Bouteloua curtipendula, Bouteloua eriopoda, Bouteloua gracilis, Chaetopappa ericoides, Ericameria nauseosa, Gutierrezia sarothrae, Hesperostipa comata, Sporobolus airoides*

VEGETATION DESCRIPTION
**Wupatki National Monument**
One-seed Juniper Cinder Wooded Herbaceous Vegetation total vegetation cover ranged from 7-48% absolute cover (average 22%) with 0-6% (average 0%) in the shrub layer and 1-27% (average 9%) in the herbaceous layer. Although the association is considered to be herbaceous, relevés were measured with low herbaceous cover. Varying depth of cinder caused broad scale patchiness of the grass species. The total species diversity ranged from 3-12 species (average 6) within the 27 relevés sampled.

The shrub layer is dominated by *Juniperus monosperma* with absolute cover ranging from 3-35% (average 13%). *Bouteloua eriopoda* and *Pleuraphis jamesii* occur frequently in the herbaceous layer; however, they do not need to be present. *Bouteloua eriopoda* ranged from 0-17% absolute cover (average 8%) and *Pleuraphis jamesii* ranged from 0-19% absolute cover (average 5%).

CONSERVATION RANK G?

DATABASE CODE CEGL005807

MAP CLASSES
The association One-seed Juniper Cinder Wooded Herbaceous Vegetation is represented by map class Oneseed Juniper Woodland (map code 27).

The total area mapped of this association within Wupatki NM is 4,240 ac (1,716 ha) within 290 polygons and the total area in the park environs is 18,666 ac (7,554 ha) within 266 polygons.

COMMENTS
**Wupatki National Monument**
These data are still under review with NatureServe to determine the range of variability in the percent cover of the understory community to still be maintained within the herbaceous alliance.

## *Gutierrezia sarothrae / Sporobolus airoides – Pleuraphis jamesii* Shrub Herbaceous Vegetation

| | |
|---|---|
| MAP CLASS | Snakeweed / Galleta Grassland |
| COMMON NAME | Snakeweed / Alkali Sacaton – Galleta Shrub Herbaceous Vegetation |
| PHYSIOGNOMIC CLASS | Herbaceous Vegetation (V.) |
| PHYSIOGNOMIC SUBCLASS | Perennial graminoid vegetation (V.A.) |
| PHYSIOGNOMIC GROUP | Temperate or subpolar grassland with a sparse shrub layer (V.A.7.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (V.A.7.N.) |
| FORMATION | Medium-tall temperate or subpolar grassland with a sparse needle-leaved or microphyllous evergreen shrub layer (V.A.7.N.e.) |
| ALLIANCE | *Pleuraphis jamesii* Shrub Herbaceous Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE

**Wupatki National Monument**

Snakeweed / Alkali Sacaton – Galleta Shrub Herbaceous Vegetation occurs infrequently over a broad range within the project boundary. This association tends to occur in naturally or anthropogenically disturbed habitats within the project boundary including within Wupatki NM, the Navajo Reservation, and Babbitt Ranches. Specifically within Wupatki NM it was found adjacent to Kana a Wash and on White Mesa, on the Navajo Reservation adjacent to Black Falls crossing, and on the Babbitt Ranches in the northwestern section near the Babbitt Ranch house.

**Globally**

This shrub steppe association occurs in the Colorado Plateau from the upper Rio Puerco watershed in northwestern New Mexico to north-central Arizona.

ENVIRONMENTAL DESCRIPTION

**Wupatki National Monument**

This association occurred over a wide range of elevations, 4,298-5,430 ft (1,310-1,655 m) (average 5,020ft/1,530 m). Slope was minimal in all sites ranging from 0-6% (average 3%). Substrate varied from a pure cinder soil to mixed cinder and clay or limestone soils as well as pure sand. Many of the relevés occurred in areas that have frequent sheet flow or in washes.

**Globally**

This Colorado Plateau desert grassland has been documented from the upper Rio Puerco watershed in northwestern New Mexico and the Painted Desert of northern Arizona on mesas and alluvial flats. Elevation ranges from 1310-1655m. Sites are level to gently sloping. Substrates are variable and include soils derived from relatively deep, fine-textured alluvium, shallow, coarse or fine loams, and pure cinder or mixed cinder and clay and limestone soils as well as pure sand (Francis 1986). Sites typically have been disturbed by improper grazing of livestock, frequent sheet flow, or wind.

MOST ABUNDANT SPECIES

**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Gutierrezia sarothrae* |
| Herbaceous | *Pleuraphis jamesii, Sporobolus airoides* |

**Globally**

| Stratum | Species |
|---|---|
| Shrub | *Gutierrezia sarothrae* |
| Herbaceous | *Pleuraphis jamesii, Sporobolus airoides* |

ASSOCIATED SPECIES

**Wupatki National Monument**

*Achnatherum hymenoides, Aristida purpurea* var. *longiseta, Atriplex canescens, Bouteloua curtipendula, Bouteloua eriopoda, Bouteloua gracilis, Ephedra torreyana, Ephedra viridis, Eriogonum corymbosum, Ericameria nauseosa, Fallugia paradoxa, Hesperostipa comata, Isocoma drummondii Juniperus monosperma, Muhlenbergia porteri*

**Globally**

*Artemisia tridentata, Atriplex canescens, Ephedra viridis, Eriogonum corymbosum, Ericameria nauseosa, Fallugia paradoxa, Isocoma drummondii, Opuntia* spp., *Juniperus monosperma, Achnatherum hymenoides, Aristida purpurea, Bouteloua curtipendula, B. eriopoda, B. gracilis, Hesperostipa comata, Muhlenbergia porteri, Spheralcea coccinea, Sporobolus cryptandrus*

VEGETATION DESCRIPTION

**Wupatki National Monument**

Snakeweed / Alkali Sacaton – Galleta Herbaceous Vegetation total vegetation cover ranged from 25-35% absolute cover (average 31%) with 18-22% (average 20%) in the shrub layer and 7-22% (average 13%) in the herbaceous layer. The total species diversity ranged from 9-15 species (average 11) within the 5 relevés sampled.

The shrub layer is dominated by *Gutierrezia sarothrae* with absolute cover ranging from 5-20% (average 15%). *Pleuraphis jamesii* and *Sporobolus airoides* both occur consistently within this association at low cover with *Pleuraphis jamesii* ranging from 2-8% absolute cover (average 5%) and *Sporobolus airoides* ranging from 2-6% absolute cover (average 3%).

**Globally**

This association is characterized by an open (10-25% cover) woody layer dominated by *Gutierrezia sarothrae* with a moderately dense perennial graminoid layer typically codominated by *Pleuraphis jamesii (= Hilaria jamesii)* and *Sporobolus airoides,* although either may dominate. The herbaceous layer has greater cover than the shrub layer that may include other scattered shrubs and dwarf-shrubs such as scattered *Artemisia tridentata, Atriplex canescens, Ephedra viridis, Eriogonum corymbosum, Ericameria nauseosa, Fallugia paradoxa, Isocoma drummondii, Opuntia* spp., or *Juniperus monosperma.* Associated herbaceous species such as *Achnatherum hymenoides, Aristida purpurea, Bouteloua curtipendula, B. eriopoda, B. gracilis, Hesperostipa comata, Muhlenbergia porteri, Sphaeralcea coccinea,* and *Sporobolus cryptandrus* may be present with low cover (Francis 1986).

CONSERVATION RANK GU

DATABASE CODE CEGL001776

MAP CLASSES

The association Snakeweed / Alkali Sacaton – Galleta Shrub Herbaceous Vegetation is represented by map class Snakeweed / Galleta Grassland (map code 13).

The total area mapped within Wupatki NM is 237 ac (96 ha) within 60 polygons and the total area in the park environs is 662 ac (268 ha) within 131 polygons.

COMMENTS

**Wupatki National Monument**

Although the global description suggests that *Sporobolus airoides* does not have to be present to be classified in this association, all relevés within our study suggest that *Sporobolus airoides* is consistent and a dominant component in this association. Currently, this association is classified as part of the *Pleuraphis jamesii* Shrub Herbaceous Alliance; however, our data suggests that *Sporobolus airoides* may be equally important in the community and could potentially be reassessed to occur within a *Sporobolus airoides* Shrub Herbaceous Alliance.

**Globally**

Stands dominated by *Sporobolus airoides* are included in this association and alliance. There is no *Sporobolus airoides* Shrub Herbaceous Alliance in the NVC.

Grazing has significantly impacted much of the vegetation in this region, which has had a long history of settlement and heavy livestock use. With proper livestock management and time, palatable species such as *Krascheninnikovia lanata* and *Sporobolus airoides* may increase, and *Gutierrezia sarothrae* and *Opuntia* spp. may decline in abundance (Francis 1986).

REFERENCES

Bourgeron and Engelking 1994, Driscoll et al. 1984, Francis 1986

## *Ericameria nauseosa / Pleuraphis jamesii – (Hesperostipa comata)* Shrub Herbaceous Vegetation

| | |
|---|---|
| MAP CLASS | Rabbitbrush Shrubland |
| COMMON NAME | Rabbitbrush / Galleta – (Needle-and-Thread) Shrub Herbaceous Vegetation |
| PHYSIOGNOMIC CLASS | Herbaceous Vegetation (V) |
| PHYSIOGNOMIC SUBCLASS | Perennial graminoid vegetation (V.A) |
| PHYSIOGNOMIC GROUP | Temperate or subpolar grassland with a sparse shrub layer (V.A.7) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural |
| FORMATION | Medium-tall temperate or subpolar grassland with a sparse needle-leaved or microphyllous evergreen shrub layer (V.A.7.N.e) |
| ALLIANCE | *Pleuraphis jamesii* Shrub Herbaceous Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE

**Wupatki National Monument**

Rabbitbrush / Galleta – (Needle-and-Thread) Herbaceous Vegetation commonly occurs within Wupatki NM. This association was found in our relevés near Kana a-wash, around Crack-in-rock road, on Antelope Prairie adjacent to Citadel Ruin, and on North Mesa. This association was not sampled outside of the monument boundaries; however, it did occur adjacent to the Babbitt Ranches on North Mesa.

ENVIRONMENTAL DESCRIPTION

**Wupatki National Monument**

This association occurred over a wide range of elevations from 4,593-5,512 ft (1,400-1,680 m) (average 5,118 ft/1,560 m) and slopes from 0-45% (average 9%). All relevés contained cinder soils with some of the relevés also containing remnant basaltic lava flow or a limestone component.

MOST ABUNDANT SPECIES

**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Ericameria nauseosa* |
| Herbaceous | *Pleuraphis jamesii*, *Hesperostipa comata* |

ASSOCIATED SPECIES

**Wupatki National Monument**

*Achnatherum hymenoides, Artemisia filifolia, Bouteloua eriopoda, Bouteloua gracilis, Ephedra torreyana, Ephedra viridis, Eriogonum corymbosum, Ericameria nauseosa, Fallugia paradoxa, Gutierrezia sarothrae, Juniperus monosperma, Muhlenbergia porteri, Rhus trilobata, Tetraclea coulteri*

VEGETATION DESCRIPTION

**Wupatki National Monument**

Rabbitbrush / Galleta – (Needle-and-Thread) Herbaceous Vegetation total vegetation cover ranged from 25-80% absolute cover (average 48%) with 7-19% (average 13%) in the shrub layer and 15-70% (average 38%) in the herbaceous layer. The total species diversity ranged from 6-16 species (average 9) within the 10 relevés sampled.

The shrub layer is dominated by *Ericameria nauseosa* with absolute cover ranging from 5-16% (average 9%). *Pleuraphis jamesii* is the dominant understory species with absolute cover ranging from 12-40% (average 22%). *Hesperostipa comata* is also a frequent but a less dominant understory component and ranged from 0-6% (average 2%).

CONSERVATION RANK G?

DATABASE CODE CEGL002996

MAP CLASSES
The association Rabbitbrush / Galleta – (Needle-and-Thread) Herbaceous Vegetation is represented by map class Rabbitbrush Shrubland (map code 17).

The total area mapped within Wupatki NM is 4,413 ac (1,786 ha) within 274 polygons and the total area in the park environs is 5,003 ac (2,025 ha) within 274 polygons.

## *Pleuraphis jamesii* Shrub Herbaceous Alliance

| | |
|---|---|
| MAP CLASS | Galleta Mixed Shrublands |
| COMMON NAME | Galleta Shrub Herbaceous Alliance |
| PHYSIOGNOMIC CLASS | Herbaceous Vegetation (V) |
| PHYSIOGNOMIC SUBCLASS | Perennial graminoid vegetation (V.A.) |
| PHYSIOGNOMIC GROUP | Temperate or subpolar grassland with a sparse shrub layer (V.A.7) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (V.A.7.N) |
| FORMATION | Medium-tall temperate or subpolar grassland with a sparse needle-leaved or microphyllous evergreen shrub layer (V.A.7.N.e) |
| ALLIANCE | *Pleuraphis jamesii* Shrub Herbaceous Alliance |

CLASSIFICATION CONFIDENCE LEVEL Alliances are not ranked by NatureServe for classification confidence.

USFS WETLAND SYSTEM Upland

RANGE

**Wupatki National Monument**

Two associations were defined as part of the *Pleuraphis jamesii* Shrub Herbaceous Alliance. However, one field relevé did not have shrub species that correspond to a pre-existing association. This relevé was measured on the rim of White House Mesa.

**Globally**

This alliance is described from the upper Rio Puerco watershed in northwestern New Mexico and adjacent Arizona. It is likely that it occurs in other parts of the Colorado Plateau.

ENVIRONMENTAL DESCRIPTION

**Wupatki National Monument**

Based on one relevé, this association was located in cinder gravel and limestone cobbles.

**Globally**

This alliance has been described from the southern Colorado Plateau in northwestern New Mexico and adjacent Arizona. The elevation ranges from 4,921-6,102 ft (1,500-1,860 m), but stands likely occur over a wider elevational and geographical range. Climate is semi-arid with most of the highly variable precipitation falling in July and August. The driest month is April. Mean annual precipitation ranges from 9-13 in (22-32 cm) within the Rio Puerco watershed. Sites occur on a variety of landforms including mesas, plains, alluvial flats and fans, floodplains, and hillslopes. Soils are shallow, poorly developed and alkaline. Soil textures range from fine sandy loam to silty clay loam to clay. The ground surface has high cover of bare ground (to 90%) with little litter or rock cover (Francis 1986). Additional survey and description work are needed to fully describe the environment of this alliance.

MOST ABUNDANT SPECIES

**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Ephedra viridis, Atriplex confertifolia* |
| Herbaceous | *Pleuraphis jamesii* |

**Globally**

| Stratum | Species |
|---|---|
| Herbaceous | *Pleuraphis jamesii* |

ASSOCIATED SPECIES

**Wupatki National Monument**

*Atriplex canescens, Bouteloua eriopoda, Hesperostipa comata, Juniperus monosperma, Lycium andersonii Muhlenbergia porteri, Sporobolus airoides*

**Globally**
*Sporobolus airoides*, *Sporobolus cryptandrus, Achnatherum hymenoides, Elymus elymoides, Muhlenbergia torreyi, Schedonnardus paniculatus*, *Bouteloua gracilis, Sphaeralcea coccinea, Astragalus* spp., *Atriplex obovata, Gutierrezia sarothrae*, *Artemisia bigelovii, Atriplex canescens, Atriplex confertifolia, Ericameria nauseosa, Ephedra* spp., *Krascheninnikovia lanata, Opuntia* spp., *Yucca* spp.

VEGETATION DESCRIPTION
**Wupatki National Monument**
Galleta Shrub Herbaceous Alliance total vegetation cover was 28%, with 12% absolute cover in the shrub layer and 14% absolute cover the herbaceous layer. Within the one relevé sampled the total species diversity was 14.

*Ephedra viridis* is the dominant species in the shrub lifeform (6% absolute cover); *Atriplex confertifolia* has the second highest cover (2.5% absolute cover). The herbaceous layer is dominated by *Pleuraphis jamesii* (11% absolute cover). *Bouteloua eriopoda* (2% absolute cover) and *Sporobolus airoides* (3% absolute cover) are also common species in the herbaceous layer.

**Globally**
This alliance is found on mesas in northwestern New Mexico and adjacent Arizona. The vegetation is dominated by a sparse to moderately dense herbaceous layer of perennial grasses that is characterized by *Pleuraphis jamesii (= Hilaria jamesii)* with a open short-shrub canopy (10-25% cover). *Pleuraphis jamesii* typically grows as a bunchgrass, but under favorable conditions may produce a sod. It dominates the herbaceous layer growing in nearly pure stands or is codominated by *Sporobolus airoides* or *Sporobolus cryptandrus*. Other common perennial grasses such as *Achnatherum hymenoides (= Oryzopsis hymenoides), Elymus elymoides, Muhlenbergia torreyi, Schedonnardus paniculatus*, or *Bouteloua gracilis* may occur in small amounts (less than half the cover of *Pleuraphis jamesii*). Forb cover is sparse and typically includes *Sphaeralcea coccinea* and *Astragalus* spp. The open short-shrub layer is often dominated by *Atriplex obovata* or *Gutierrezia sarothrae*, but may include may other shrubs and dwarf-shrubs such as *Artemisia bigelovii, Atriplex canescens, Atriplex confertifolia, Ericameria nauseosa, Ephedra* spp., *Krascheninnikovia lanata, Opuntia* spp., or *Yucca* spp., with less than 25% total cover. Total vegetation cover ranges from 10-75% with graminoids making up 8-60% cover. The sparse stands described by Francis (1986) may indicate a seral/degraded state and need further review.

CONSERVATION RANK G2G4

DATABASE CODE A.1532

MAP CLASSES
Galleta Shrub Herbaceous Alliance is represented by the map class Galleta Mixed Shrublands (map code 14).

The total area mapped within Wupatki NM is 1,315 ac (532 ha) within 255 polygons and the total area in the park environs is 1,213 ac (491 ha) within 107 polygons.

COMMENTS
**Wupatki National Monument**
Two associations were defined as part of the *Pleuraphis jamesii* Shrub Herbaceous Alliance (*Gutierrezia sarothrae / Sporobolus airoides – Pleuraphis jamesii* Shrub Herbaceous Vegetation and *Ericameria nauseosa / Pleuraphis jamesii –* (*Hesperostipa comata*) Shrub Herbaceous Vegetation). The one field relevé described in this vegetation description represented a community composition that did not correlate to a pre-existing association. With only one relevé described of this type, we were unable to define a provisional association and described this community to a coarser community classification using a pre-existing alliance. This community type, if described elsewhere on the Colorado Plateau, may be classified into an association with additional field sampling.

**Globally**
The main difference between stands in this alliance and the *Pleuraphis jamesii* Herbaceous Alliance (A.1287) is the presence of a significant woody layer composed of shrubs and dwarf-shrubs. However, stands described by Francis (1986) have less than 10% total vegetation cover and may be better classified in a sparsely vegetated alliance. Further confusing this type, Francis (1986) includes degraded stands of the *Sporobolus airoides - Pleuraphis jamesii*

alluvial flats plant community in this mesa top plant community. Francis (1986) also described many other plant communities in the Upper Rio Puerco watershed, some of which may also fit the concept of this alliance. This alliance description is based on two plant community descriptions by Francis (1986) and work done at Petrified Forest National Monument. Some stands included in this alliance may form a transitional stage between *Pleuraphis jamesii - Sporobolus airoides* grasslands and *Atriplex obovata* dwarf-shrublands. Further study is needed, especially on the effects of livestock grazing on vegetation structure.

DYNAMICS
Grazing has significantly impacted much of the vegetation in this region, which has had a long history of settlement and heavy livestock use. With proper livestock management and time, palatable species such as *Krascheninnikovia lanata* and *Sporobolus airoides* may increase, and *Gutierrezia sarothrae* and *Opuntia* spp. may decline in abundance (Francis 1986).

REFERENCES
Francis 1986, West et al. 1972

## *Pleuraphis jamesii – Sporobolus airoides* Herbaceous Vegetation

| | |
|---|---|
| MAP CLASS | Galleta Mixed Grasslands |
| COMMON NAME | Galleta – Alkali Sacaton Herbaceous Vegetation |
| PHYSIOGNOMIC CLASS | Herbaceous Vegetation (V.) |
| PHYSIOGNOMIC SUBCLASS | Perennial graminoid vegetation (V.A.) |
| PHYSIOGNOMIC GROUP | Temperate or subpolar grassland (V.A.5.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (V.A.5.N.) |
| FORMATION | Short sod temperate or subpolar grassland (V.A.5.N.e.) |
| ALLIANCE | *Pleuraphis jamesii* Herbaceous Alliance |

CLASSIFICATION CONFIDENCE LEVEL Moderate

USFS WETLAND SYSTEM Upland

RANGE

**Wupatki National Monument**

Galleta – Alkali Sacaton Herbaceous Vegetation is a common herbaceous physiognomic class that occurs on the Babbitt Ranches, Arizona State Lands, and Wupatki NM. This association was found to occur from our relevé data on the Babbitt Ranches on top of White Mesa, near the Bar Doney Tank and west of the Little Colorado River along the Crack-in-rock Road. On state lands this association is known from the southeastern ranch lands south of Kana a Wash. Within Wupatki NM this association was recorded from southeastern corner near Kana a Wash and Wukoki Ruins.

**Globally**

This once-extensive grassland of the northern Chihuahuan Desert, Colorado Plateau and Great Basin is reported in New Mexico from White Sands Missile Range and the upper Rio Puerco watershed, and in north-central Arizona. It has experienced significant declines throughout its range.

ENVIRONMENTAL DESCRIPTION

**Wupatki National Monument**

This association occurs over a wide range of elevations within the park and the environs 4,265-5,085 ft (1,300-1,550 m) (average 4,822 ft/1,470 m). Slope ranged from 0-15% (average 4%). Substrate varied from remnant lava flow, cinders, clay soils, to relic Pleistocene river cobbles.

**Globally**

This grassland is described in New Mexico from White Sands Missile Range and the upper Rio Puerco watershed, and in north-central Arizona. This association primarily occurs in swales within open valley bottoms and alluvial flats (<15% slope) at elevations between 4,260-6,800 ft (1,300-2,075 m). Substrates tend to be deep soils with surface textures ranging from fine loams to silty clay loams and clays, but include remnant lava flow, cinders, and relic Pleistocene river cobbles (Francis 1986, Muldavin et al. 2000a).

MOST ABUNDANT SPECIES

**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Herbaceous | *Pleuraphis jamesii, Sporobolus airoides* |

**Globally**

| Stratum | Species |
|---|---|
| Herbaceous | *Pleuraphis jamesii, Sporobolus airoides* |

ASSOCIATED SPECIES

**Wupatki National Monument**

*Atriplex confertifolia, Ephedra torreyana, Gutierrezia sarothrae, Muhlenbergia porteri, Opuntia macrorhiza*

**Globally**
*Atriplex canescens, A. confertifolia, A. obovata, Ephedra torreyana, Gutierrezia sarothrae, Krascheninnikovia lanata, Opuntia imbricata, O. macrorhiza, O. phaeacantha, Achnatherum hymenoides, Bouteloua gracilis, Muhlenbergia porteri, M. torreyi, Pascopyrum smithii, Scleropogon brevifolius, Sphaeralcea coccinea, Sporobolus cryptandrus*

VEGETATION DESCRIPTION
**Wupatki National Monument**
Galleta – Alkali Sacaton Herbaceous Vegetation total vegetation cover ranged from 23-70% absolute cover (average 43%) with 0-8% (average 3%) in the shrub layer and 16-60% (average 40%) in the herbaceous layer. The total species diversity ranged from 4-14 species (average 7) within the 5 relevés sampled.

The shrub layer is not dominated by a single species. In the herbaceous layer *Pleuraphis jamesii* is the dominant understory species with absolute cover ranging from 9-50% (average 26%). *Sporobolus airoides* is always present in high cover, but at Wupatki NM it is never the dominant herbaceous species. Its absolute cover ranges from 6-18% (average 13%).

**Globally**
This association is characterized by a sparse to moderately dense perennial herbaceous layer that is dominated by *Pleuraphis jamesii (= Hilaria jamesii)* with *Sporobolus airoides* as a subdominant. Occasionally, *Sporobolus airoides* may be codominant or dominant over *Pleuraphis jamesii.* This association usually has a sparse but diverse shrub layer that may include scattered *Atriplex canescens, A. confertifolia, A. obovata, Ephedra torreyana, Gutierrezia sarothrae, Krascheninnikovia lanata, Opuntia imbricata, O. macrorhiza,* and *O. phaeacantha*. The key graminoid species dominate the herbaceous layer and account for more than 80% of the total percent plant cover. Associated herbaceous species such as *Achnatherum hymenoides, Bouteloua gracilis, Muhlenbergia porteri, M. torreyi, Pascopyrum smithii, Scleropogon brevifolius, Sphaeralcea coccinea,* and *Sporobolus cryptandrus* may be present with low cover (Francis 1986, Muldavin et al. 2000a).

CONSERVATION RANK G2G3

DATABASE CODE CEGL001778

MAP CLASSES
Galleta – Alkali Sacaton Herbaceous Vegetation is represented by map class Galleta Mixed Grasslands (map code 11).

The map class Galleta Mixed Grasslands includes the following combined associations: *Pleuraphis jamesii-Sporobolus airoides* Herbaceous Vegetation and *Bouteloua eriopoda - Pleuraphis jamesii* Herbaceous Vegetation.

The total area mapped within Wupatki NM is 7,270 ac (2,942 ha) within 374 polygons and the total area in the park environs is 22,025 ac (8,913 ha) within 427 polygons.

**Global Comments**
In the classification of the plant communities of the upper Rio Puerco watershed, Francis (1986) described two plant communities codominated by *Pleuraphis jamesii - Sporobolus airoides* that were separated by the relative dominance of the key species. Both plant communities were combined into this association.

This once extensive grassland of the Great Basin and Chihuahuan Desert Ecoregions has been described in New Mexico from the Upper Rio Puerco watershed and White Sands Missile Range. It has experienced significant declines throughout its range. Remaining examples that have not been negatively impacted by grazing and/or invaded by shrubs are rare. However, this Great Basin grassland is probably more widespread than is documented and hence the rank of G2G3.

REFERENCES
Bourgeron and Engelking 1994, Driscoll et al. 1984, Francis 1986, Muldavin et al. 1998, Muldavin et al. 2000a, West et al. 1972

## *Pleuraphis jamesii* Herbaceous Vegetation

| | |
|---|---|
| MAP CLASS | Galleta Grassland |
| COMMON NAME | Galleta Herbaceous Vegetation |
| PHYSIOGNOMIC CLASS | Herbaceous Vegetation (V.) |
| PHYSIOGNOMIC SUBCLASS | Perennial graminoid vegetation (V.A.) |
| PHYSIOGNOMIC GROUP | Temperate or subpolar grassland (V.A.5.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (V.A.5.N.) |
| FORMATION | Short sod temperate or subpolar grassland (V.A.5.N.e.) |
| ALLIANCE | *Pleuraphis jamesii* Herbaceous Alliance |

CLASSIFICATION CONFIDENCE LEVEL Moderate

USFS WETLAND SYSTEM Upland

RANGE

**Wupatki National Monument**

Galleta Herbaceous Vegetation is one of the most common associations within the project boundaries. This association was found from our relevé data at Wupatki NM in the southeastern section of the park west of the Little Colorado River, along Crack-in-rock Road, on Antelope Prairie, Woodhouse Mesa, Doney Mountain, White Mesa, and near Wupakti and Wukoki Ruins. This association was also found on Babbitt Ranch land on top of White Mesa, adjacent to the Babbitt Ranch houses and along the Lomatki Ruins service road.

**Globally**

This widespread grassland association is found on alluvial flats, plateau parks and plains in the Colorado Plateau and elsewhere in the southwestern U.S.

ENVIRONMENTAL DESCRIPTION

**Wupatki National Monument**

This association occurs over a wide range of elevations and slopes within the park and the environs ranging from 4,364-5,446 ft (1,330-1,660 m) elevation (average 5,069 ft/1,545 m) and 0-65% slope (average 16%). Its substrate included different geologic formations within the parks remnant lava flow and basaltic cobbles, black and red cinders, relic Pleistocene river cobbles, sandstone, sand, and clay soils.

**Globally**

This widespread grassland association is found on alluvial flats, plateau parks and plains in the Colorado Plateau and elsewhere in the southwestern U.S. Elevation ranges from 4,003-5,446 ft (1,220-1,660 m). Landforms vary from mesa tops, slopes, and basin floors. Stands may be small woodland parks or more extensive on the plains. Soils are variable. In bottomland stands soils tend to be fine-textured; however, stands also occur on sandy loams derived from sandstone, remnant lava flow, basaltic cobbles, black or red cinders, or alluvium derived from relic Pleistocene river cobbles, sandstone, sand, or clay soils.

MOST ABUNDANT SPECIES

**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Herbaceous | *Pleuraphis jamesii* |

**Globally**

| Stratum | Species |
|---|---|
| Herbaceous | *Pleuraphis jamesii* |

ASSOCIATED SPECIES

**Wupatki National Monument**

*Aristida havardii, Aristida purpurea, Artemisia dracunculus, Atriplex canescens, Bouteloua eriopoda, Brickellia oblongifolia, Dasyochloa pulchella, Elymus elymoides, Ephedra torreyana, Ephedra viridis, Ericameria nauseosus,*

*Fallugia paradoxa, Gutierrezia sarothrae, Hesperostipa comata, Muhlenbergia porteri, Sporobolus airoides, Zinnia grandiflora*

**Globally**
*Aristida* spp., *Achnatherum hymenoides, Bouteloua eriopoda, Bouteloua gracilis, Hesperostipa comata, Muhlenbergia porteri, Sporobolus airoides*, *Sporobolus cryptandrus, Plantago* sp., *Gilia* sp., *Lappula* sp., *Zinnia* sp., *Opuntia* sp. *Artemisia filifolia, Atriplex canescens, Atriplex confertifolia, Brickellia oblongifolia, Ephedra torreyana, E. viridis, Ericameria nauseosa, Fallugia paradoxa, Gutierrezia* spp., *Tetradymia* spp., *Juniperus monosperma*

VEGETATION DESCRIPTION
**Wupatki National Monument**
Galleta Herbaceous Vegetation total vegetation cover ranged from 16-65% absolute cover (average 40%) with 1-10% (average 4%) in the shrub layer and 11-61% (average 36%) in the herbaceous layer. Diversity ranged from low (2) to high (17) species (average 10) within the 15 relevés sampled.

The shrub layer is not dominated by a single species; however, the most consistent shrubs species were *Ericameria nauseosa* with 0-3% absolute cover (average 1%) and *Atriplex canescens* with 0-10% absolute cover (average 1%). In the herbaceous layer *Pleuraphis jamesii* is the dominant understory species with absolute cover ranging from 10-55% (average 32%).

**Globally**
This association is characterized by a relatively sparse to moderately dense perennial herbaceous layer (10-60% cover) that is strongly dominated by the warm-season bunchgrass *Pleuraphis jamesii*. Low cover of other grasses such as *Aristida* spp., *Achnatherum hymenoides, Bouteloua eriopoda, Bouteloua gracilis, Hesperostipa comata, Muhlenbergia porteri, Sporobolus airoides*, or *Sporobolus cryptandrus* may be present. Forb cover is usually sparse and includes species of *Plantago, Gilia, Lappula, Zinnia,* and prickly pear cacti (*Opuntia* spp.). Many species of shrubs and dwarf-shrubs may be present, but they are not abundant enough to form a shrub layer. Woody species may include *Artemisia filifolia, Atriplex canescens, Atriplex confertifolia, Brickellia oblongifolia, Ephedra torreyana, E. viridis, Ericameria nauseosa, Fallugia paradoxa, Gutierrezia* spp., *Tetradymia* spp., and occasional *Juniperus monosperma* trees. The widespread introduced annual grass *Bromus tectorum* and several other exotic species like *Salsola kali, Bassia scoparia (= Kochia scoparia),* and *Sisymbrium altissimum* may be present to abundant, especially on disturbed sites. Some stands have high cover of cryptogams on the soil including *Collema tenax, Tortula ruralis, Bellia papillata*, and *Fulgensia bracteata*.

CONSERVATION RANK G2G4

DATABASE CODE CEGL001777

MAP CLASSES
Galleta Herbaceous Vegetation is represented by map class Galleta Grassland (map code 10).

The total area mapped within Wupatki NM is 62 ac (25 ha) within 24 polygons and the total area in the park environs is 583 ac (236 ha) within 94 polygons.

COMMENTS
**Globally**
This association is defined by the dominance of *Pleuraphis jamesii* in the graminoid layer without codominance of other grass species or the presence of a shrub layer.

DYNAMICS
*Pleuraphis jamesii* is both drought- and grazing-resistant (USFS 1937, Weaver and Albertson 1956, West et al. 1972). This grass is favored in mixedgrass stands because it is only moderately palatable to livestock; however, it decreases when heavily grazed during drought and in the more arid portions of its range where it is the dominant grass (West et al. 1972). This grass reproduces extensively from scaly rhizomes. These rhizomes make the plant

resistant to trampling by livestock and have good soil binding properties (USFS 1937, Weaver and Albertson 1956, West et al. 1972).

REFERENCES

Bourgeron and Engelking 1994, Cannon 1960, Collins 1984, Driscoll et al. 1984, Francis 1986, Francis and Aldon 1983, Helm 1981, Kleiner 1968, Kleiner 1983, Kleiner and Harper 1972, Kleiner and Harper 1977, Marr et al. 1973, Nichol 1937, Stewart et al. 1940, USFS 1937, Utah Environmental and Agricultural Consultants 1973, Von Loh et al. 2002, Weaver and Albertson 1956, West et al. 1972

## *Sporobolus airoides* Herbaceous Vegetation

| | |
|---|---|
| MAP CLASS | Wupatki Wash System |
| COMMON NAME | Alkali Sacaton Herbaceous Vegetation |
| PHYSIOGNOMIC CLASS | Herbaceous Vegetation (V.) |
| PHYSIOGNOMIC SUBCLASS | Perennial graminoid vegetation (V.A.) |
| PHYSIOGNOMIC GROUP | Temperate or subpolar grassland (V.A.5.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (V.A.5.N.) |
| FORMATION | Medium-tall bunch temperate or subpolar grassland (V.A.5.N.e.) |
| ALLIANCE | *Sporobolus airoides* Herbaceous Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE

**Wupatki National Monument**

Alkali Sacaton Herbaceous Vegetation is a common association in the wash systems and in southeastern section of the project boundary. This association was found from our relevé data to occur on NPS lands, Babbitt lands, and Navajo Nation lands. In the park Alkali Sacaton Herbaceous Vegetation was located along the Little Colorado River corridor south of Black Falls Crossing and near Wukoki Ruins. It was located on the Navajo Nation along the Little Colorado River corridor north of Black Falls Crossing. On Babbitt lands it was located in side washes of the Little Colorado River.

**Globally**

This alkali sacaton mesic grassland community is found in the southwestern Great Plains and elsewhere in the southwestern United States and Mexico, ranging from Kansas and Colorado south to Texas, New Mexico and west to Arizona, Utah and possibly California.

ENVIRONMENTAL DESCRIPTION

**Wupatki National Monument**

This association's elevations ranged from 4,265-4,593 ft (1,300-1,400 m) (average 4,364 ft/1,330 m) and slope ranged from 0-30% (average 7%). The substrate varies depending on locations within the project boundary and includes lava flow, cinders, relic Pleistocene river cobbles, sandstone, sand, and clay soils. All of the relevés were located in washes and sheetflow runoff areas.

**Globally**

This grassland community occurs on alluvial toeslopes and flats, terraces, floodplain depressions, and sandy streambanks and washes in bottomlands throughout the southern Great Plains and Colorado Plateau. Elevations range from below 3,050 ft (1,000 m) to over 6,100 ft (2,000 m). Sites are typically flat to gently sloping but range to 30%. Soils are shallow to moderately deep, moderately well- to poorly drained, alkaline, and often saline with typically fine-textured silts or clays often derived from shale (Francis 1986, Johnston 1987, Kittel et al. 1999, Lauver et al. 1999, Von Loh et al. 2002). Other parent materials include lava flow, cinders, relic Pleistocene river cobbles, sandstone, and sand.

MOST ABUNDANT SPECIES

**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Herbaceous | *Sporobolus airoides* |

ASSOCIATED SPECIES

**Wupatki National Monument**

*Achnatherum hymenoides, Artemisia ludoviciana, Astragalus praelongus, Atriplex canescens, Atriplex confertifolia, Ephedra nevadensis, Ephedra torreyana, Ephedra viridis, Ericameria nauseosus, Gutierrezia sarothrae, Isocoma pluriflora, Muhlenbergia porteri, Pleuraphis jamesii, Salsola tragus, Sphaeralcea hastulata, Tiquilia latior*

**Globally**
*Achnatherum hymenoides*, *Symphyotrichum subulatum, Buchloe dactyloides, Distichlis spicata, Hordeum jubatum, Bouteloua gracilis, Panicum obtusum, Pleuraphis jamesii, Sphaeralcea* spp, *Sporobolus cryptandrus*, and *Pascopyrum smithii, Atriplex canescens, A. confertifolia, Ephedra* spp., *Ericameria nauseosus, Gutierrezia sarothrae, Sarcobatus vermiculatus*

VEGETATION DESCRIPTION
**Wupatki National Monument**
Alkali Sacaton Herbaceous Vegetation total vegetation cover ranged from 20-46% absolute cover (average 28%) with 4-20% (average 10%) in the shrub layer and 11-26% (average 19%) in the herbaceous layer. Diversity ranged from 8-15 species (average 11) within the 8 relevés sampled.

The herbaceous layer is dominated by *Sporobolus airoides* with absolute cover ranging from 8-26% (average 15%). Shrubs such as *Ephedra spp., Atriplex spp.* and *Gutierrezia sarothrae* are occasionally present. The shrub layer is never the dominant component to this association

**Globally**
This association is characterized by a sparse to moderately dense (20-60% cover), medium-tall graminoid layer dominated by *Sporobolus airoides*. Associated species include *Achnatherum hymenoides*, *Symphyotrichum subulatum (= Aster subulatus), Buchloe dactyloides, Distichlis spicata, Hordeum jubatum, Bouteloua gracilis, Panicum obtusum, Pleuraphis jamesii, Sphaeralcea* spp, *Sporobolus cryptandrus*, and *Pascopyrum smithii* (Francis 1986, Johnston 1987, Kittel et al. 1999, Lauver et al. 1999, Von Loh et al. 2002). Scattered shrubs may be present such as *Atriplex canescens, A. confertifolia, Ephedra* spp., *Ericameria nauseosus, Gutierrezia sarothrae,* or *Sarcobatus vermiculatus*. Total shrub cover is low (<10%) and forb cover is minor.

CONSERVATION RANK G3Q

DATABASE CODE CEGL001685

MAP CLASSES
The association Alkali Sacaton Herbaceous Vegetation is represented by map class Wupatki Wash System (map code 24).

The Wupatki Wash System is a mosaic of associations that includes: *Sporobolus airoides* Herbaceous Vegetation, *Artemisia filifolia – Ephedra (torreyana, viridis)* Shrubland, *Atriplex canescens / Sporobolus airoides* Shrubland, *Atriplex canescens* Desert Wash Shrubland (Provisional), and *Fallugia paradoxa – (Atriplex canescens – Ephedra torreyana)* Cinder Shrubland.

The total area mapped within Wupatki NM is 1,384 ac (560 ha) within 182 polygons and the total area in the park environs is 939 ac (380 ha) within 123 polygons.

**Global Comments**
Compare this association with *Sporobolus airoides - Bouteloua gracilis* Herbaceous Vegetation (CEGL001686) and *Pleuraphis jamesii - Sporobolus airoides* Herbaceous Vegetation (CEGL001778). Stands in Montana are placed with *Sporobolus airoides* Northern Plains Herbaceous Vegetation (CEGL002274), which occurs in the northwestern Great Plains, and this type is restricted to the southwestern Great Plains and southwestern United States. In the southeastern Plains see *Distichlis spicata - (Hordeum jubatum, Poa arida, Sporobolus airoides)* Herbaceous Vegetation (CEGL002042).

DYNAMICS
This is an early-seral community that occurs on floodplains and depressions with moderately saline soils (Aldous and Shantz 1924 as cited in Johnston 1987). While the stand sampled may be flooded infrequently, other stands of *Sporobolus airoides* (alkali sacaton) are reported to occur on soils not flooded but with high water tables because of land position. The intermittent flood regime affects soil moisture and salinity which can alter species composition. Sudden increases in salinity will result in a decrease in cover of *Sporobolus airoides*. With no change in salinity, this plant association will form hummocks that accumulate sand. Gradually the sites will decrease in salinity, and

moisture and invasion by other grasses will follow (Ungar 1974a as cited in Johnston 1987). Soils are non-saline to moderately saline and usually alkaline. *Sporobolus airoides* will decrease in abundance with increased soil salinity.

REFERENCES

Aldous and Shantz 1924, Bourgeron and Engelking 1994, Driscoll et al. 1984, Francis 1986, Johnston 1987, Kittel and Lederer 1993, Kittel et al. 1999, Lauver et al. 1999, Lindauer 1970, Soil Conservation Service 1978, Steward 1982, Von Loh et al. 2002

## *Tiquilia latior / Sporobolus airoides* Dwarf-shrubland [Provisional]

| | |
|---|---|
| MAP CLASS | Crinklemat / Alkali Sacaton Dwarf Shrubland |
| COMMON NAME | Matted Crinklemat / Alkali Sacaton Dwarf-Shrubland |
| PHYSIOGNOMIC CLASS | Dwarf-shrubland (IV) |
| PHYSIOGNOMIC SUBCLASS | Evergreen dwarf-shrubland (IV.A) |
| PHYSIOGNOMIC GROUP | Extremely xeromorphic evergreen dwarf-shrubland (IV.A.2) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (IV.A.2.N) |
| FORMATION | Extremely xeromorphic evergreen subdesert dwarf-shrubland (IV.A.2.N.a) |
| ALLIANCE | *Tiquilia latior* Dwarf-Shrubland Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE
**Wupatki National Monument**
Matted Crinklemat / Alkali Sacaton Dwarf-Shrubland is only known from one location in the project boundary. This association was found at Wupatki NM adjacent to the Little Colorado River corridor near Black Falls Crossing.

ENVIRONMENTAL DESCRIPTION
**Wupatki National Monument**
This association was found at an elevation of 4,265 ft (1,300 m) with no slope. The substrate consisted of red sand, black cinders, and relict Pleistocene river cobbles.

MOST ABUNDANT SPECIES
**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Dwarf-Shrub | *Tiquilia latior* |
| Herbaceous | *Sporobolus airoides* |

ASSOCIATED SPECIES
**Wupatki National Monument**
*Atriplex canescens, Atriplex confertifolia*

VEGETATION DESCRIPTION
**Wupatki National Monument**
Only one relevé was assigned to the association Matted Crinklemat / Alkali Sacaton Dwarf-Shrubland. Total vegetation was 22% absolute cover with 16% in the shrub layer and 5% in the ground layer. Species diversity consists of 8 species.

The dwarf-shrub layer is dominated by *Tiquilia latior* with 4% absolute cover. The herbaceous layer is dominated by *Sporobolus airoides* with 4% absolute cover.

CONSERVATION RANK G?

DATABASE CODE CEGL005809

MAP CLASSES
The association Matted Crinklemat / Alkali Sacaton Dwarf-Shrubland is represented by map class Crinklemat / Alkali Sacaton Dwarf Shrubland (map code 12).

The total area mapped within Wupatki NM is 217 ac (88 ha) within 8 polygons and the total area in the park environs is 30 ac (12 ha) within 3 polygons.

COMMENTS

**Wupatki National Monument**

This association is only known from one location within the park; however, with more extensive sampling along the Colorado River on basaltic substrate we believe that additional examples of this association may have been located.

## *Alhagi maurorum* Semi-natural Shrubland

| | |
|---|---|
| MAP CLASS | Little Colorado River Invasive Riparian Shrubland |
| COMMON NAME | Camelthorn Semi-natural Shrubland |
| PHYSIOGNOMIC CLASS | Shrubland (III) |
| PHYSIOGNOMIC SUBCLASS | Deciduous shrubland (III.B) |
| PHYSIOGNOMIC GROUP | Drought-deciduous shrubland (III.B.1) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (III.B.1.N) |
| FORMATION | Lowland drought-deciduous shrubland (III.B.1.N.a) |
| ALLIANCE | *Alhagi maurorum* Semi-natural Shrubland Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE
**Wupatki National Monument**
Camelthorn Semi-natural Shrubland is only known from one location in the project boundary. This association was found on the banks of the Little Colorado River near Black Falls Crossing within Wupatki NM.

ENVIRONMENTAL DESCRIPTION
**Wupatki National Monument**
This association was found at an elevation of 4,265 ft (1,300 m) with level slope. The substrate consisted of a sandy riverbank with some clay soils.

MOST ABUNDANT SPECIES
**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Alhagi maurorum* |

ASSOCIATED SPECIES
**Wupatki National Monument**
*Gutierrezia sarothrae, Salsola kali, Sporobolus airoides, Tamarix chinensis*

VEGETATION DESCRIPTION
**Wupatki National Monument**
Only one relevé was identified as the association Camelthorn Semi-natural Shrubland. Total vegetation was 18% absolute cover with 13% in the shrub layer and 5% in the ground layer. Species diversity consists of 17 species; however, this high diversity is represented by a high percentage of exotic species with five of the 17 species being non-native exotic species.

The shrub layer is dominated by *Alhagi maurorum* with 10% absolute cover. The herbaceous layer is not dominated by a single species.

CONSERVATION RANK GW

DATABASE CODE CEGL002784

MAP CLASSES
The association Camelthorn Semi-natural Shrubland is represented by map class Little Colorado River Invasive Riparian Shrubland (map code 26).

The map class Little Colorado River Invasive Riparian Shrubland also includes the association *Tamarix spp.* Temporarily Flooded Shrubland.

The total area mapped within Wupatki NM is 77 ac (31 ha) within 8 polygons and the total area in the park environs is 1,774 ac (718 ha) within 74 polygons.

COMMENTS

**Wupatki National Monument**

Although only one relevé of this proposed association was described from the project, we have observed that this invasive association is not unique and occurs within other disturbed/riparian areas on the Colorado Plateau.

## *Artemisia filifolia – Ephedra (torreyana, viridis)* Shrubland

| | |
|---|---|
| MAP CLASS | Sand Sagebrush Shrubland, Wupatki Wash System |
| COMMON NAME | Sand Sagebrush – (Torrey's Joint-fir, Mormon-tea) Shrubland |
| PHYSIOGNOMIC CLASS | Shrubland (III) |
| PHYSIOGNOMIC SUBCLASS | Evergreen shrubland (III.A) |
| PHYSIOGNOMIC GROUP | Microphyllous evergreen shrubland (III.A.4) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (III.A.4.N) |
| FORMATION | Lowland microphyllous evergreen shrubland (III.A.4.N.a) |
| ALLIANCE | *Artemisia filifolia* Shrubland Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE

**Wupatki National Monument**

Sand Sagebrush – (Torrey's Joint-fir, Mormon-tea) Shrubland is one of the most common shrubland associations in the south central section of the project boundary. This association was identified from our relevé data only within Wupatki NM lands; however, more extensive sampling in the project environs may result in expanded distribution ranges. Within Wupatki NM it was identified east of Black Mesa near Kana a Wash, Dead Man's Wash, Wukoki Ruins, Wupatki Ruins, and a Navajo's home site.

ENVIRONMENTAL DESCRIPTION

**Wupatki National Monument**

This association's elevation ranged from 4,380-4,888 ft (1,335-1,490 m) (average 4,724 ft/1,440 m) and slope ranged from 0-12% (average 5%). The substrate is black cinder with a layer of sandstone cobbles. This association is sometimes found in washes or sheetflow areas.

MOST ABUNDANT SPECIES

**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Artemisia filifolia, Ephedra torreyana, Ephedra viridis* |

ASSOCIATED SPECIES

**Wupatki National Monument**

*Achnatherum hymenoides, Aristida purpurea, Artemisia bigelovii, Atriplex canescens, Artemisia dracunculus, Atriplex confertifolia, Bouteloua eriopoda, Ericameria nauseous, Eriogonum corymbosum, Fallugia paradoxa, Gutierrezia sarothrae, Lycium pallidum, Muhlenbergia porteri, Pleuraphis jamesii, Sphaeralcea parvifolia, Sporobolus airoides, Tetraclea coulteri, Yucca angustissima, Zinnia grandiflora*

VEGETATION DESCRIPTION

**Wupatki National Monument**

Sand Sagebrush – (Torrey's Joint-fir, Mormon-tea) Shrubland total vegetation cover ranged from 15-30% absolute cover (average 24%) with 15-34% (average 20%) in the shrub layer and 1-15% (average 6%) in the herbaceous layer. Diversity ranged from 7-27 species (average 12) within the 14 relevés sampled.

The shrub layer was not dominated by a single species but rather by a group of species that co-dominate. *Artemisia filifolia* is the only consistent shrub to occur within the association and functions as an indicator species. Its absolute cover ranges from low to moderate, 1-18% (average 6%). Other shrubs can occur and can dominate or co-dominate within this association but they do not have to be present. These main shrubs consists of *Ephedra torreyana* with 0-9% absolute cover (average 4%), *Ephedra viridis* with 0-4% absolute cover (average 1%), *Ericameria nauseosa* with 0-12% absolute cover (average 2%), *Gutierrezia sarothrae* with 0-9% absolute cover (average 3%), and *Atriplex canescens* with absolute cover 0-7% (average 2%). The herbaceous layer is not dominated by a single species.

CONSERVATION RANK G?

DATABASE CODE CEGL002786

MAP CLASSES
The association Sand Sagebrush – (Torrey's Joint-fir, Mormon-tea) Shrubland is represented by map class Sand Sagebrush Shrubland (map code 19) and may also occur as a mosaic within the Wupatki Wash System (map code 24).

The Wupatki Wash System is a mosaic of associations that includes: *Sporobolus airoides* Herbaceous Vegetation, *Artemisia filifolia – Ephedra (torreyana, viridis)* Shrubland, *Atriplex canescens / Sporobolus airoides* Shrubland, *Atriplex canescens* Desert Wash Shrubland (Provisional), and *Fallugia paradoxa – (Atriplex canescens – Ephedra torreyana)* Cinder Shrubland.

The total areas mapped of Sand Sagebrush Mixed Shrubland within Wupatki NM is 1,888 ac (764 ha) within 80 polygons and the total area in the park environs is 42 ac (17 ha) within 8 polygons. The total area mapped of the complex Wupatki Wash System within Wupatki NM is 1,384 ac (560 ha) within 182 polygons and the total area in the park environs is 939 ac (380 ha) within 123 polygons.

COMMENTS
**Wupatki National Monument**
*Artemisia filifolia* is an indicator species within this association and can occur in low cover with other shrubs; these shrubs may not be listed in the NVC association name and may dominate cover in the shrub layer. *Artemisia filifolia*'s indicator status may need to be reassessed with additional relevé data.

**Note:**
This association is found in two different map classes:
1) Sand Sagebrush Shrubland
2) Wupatki Wash System

## *Atriplex canescens / Sporobolus airoides* Shrubland

| | |
|---|---|
| MAP CLASS | Wupatki Wash System |
| COMMON NAME | Fourwing Saltbush / Alkali Sacaton Shrubland |
| PHYSIOGNOMIC CLASS | Shrubland (III.) |
| PHYSIOGNOMIC SUBCLASS | Evergreen shrubland (III.A.) |
| PHYSIOGNOMIC GROUP | Extremely xeromorphic evergreen shrubland (III.A.5.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (III.A.5.N.) |
| FORMATION | Facultatively deciduous extremely xeromorphic subdesert shrubland (III.A.5.N.b.) |
| ALLIANCE | *Atriplex canescens* Shrubland Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE

**Wupatki National Monument**

Fourwing Saltbush / Alkali Sacaton Shrubland occurs in small patches within washes or runoff areas in the project boundary. This association was only identified from our relevé data within Wupatki NM adjacent to Deadman's Wash; however, additional occurrences in the park environs may be found with additional sampling.

**Globally**

This shrubland occurs in the northern Chihuahua Desert extending into Trans-Pecos Texas, the southwestern Great Plains and Colorado Plateau in Colorado, New Mexico, Arizona, and Utah. It is reported from California and likely also occurs in Nevada and Mexico.

ENVIRONMENTAL DESCRIPTION

**Wupatki National Monument**

The two relevés of this association sampled had elevations of 1308 and 1309m and slope of 1 and 5%. The substrate consisted of clay soils and cinder sand.

**Globally**

This shrubland occurs in the northern Chihuahua Desert extending into the Trans-Pecos of Texas, southwestern Great Plains, and Colorado Plateau. Sites are in washes and on alluvial flats, extending up lower slopes of alluvial fans or bajadas. Elevation ranges from 3002-6,201 ft (915-1,890 m). Sites are level to gently sloping (1-2%), and substrates are typically moderately deep, alkaline, calcareous, fine-textured soils such as loamy clay or clay (Francis 1986, Muldavin et al. 2000a, Shaw et al. 1989). Cover of bare soil may be high (>50%) (Francis 1986). Evidence of overland flow and erosion, e.g., gullies, rills, plant pediceling is common (Soil Conservation Service n.d.).

MOST ABUNDANT SPECIES

**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Atriplex canescens* |
| Herbaceous | *Sporobolus airoides* |

**Globally**

| Stratum | Species |
|---|---|
| Shrub | *Atriplex canescens* |
| Herbaceous | *Sporobolus airoides* |

ASSOCIATED SPECIES

**Wupatki National Monument**

*Artemisia filifolia, Gutierrezia sarothrae, Isocoma pluriflora, Salsola kali*

**Globally**
*Artemisia filifolia, Atriplex confertifolia, A. obovata, Chrysothamnus viscidiflorus, Ericameria nauseosa, Gutierrezia sarothrae, Isocoma pluriflora, Krascheninnikovia lanata, Lycium berlandieri, L. pallidum, Opuntia imbricata, O. leptocaulis, O. phaeacantha*, *Prosopis glandulosa*, *Sarcobatus vermiculatus, Elymus elymoides, Pascopyrum smithii, Pleuraphis jamesii, Sphaeralcea coccinea, Sporobolus cryptandrus, Sporobolus nealleyi, Suaeda* spp.

VEGETATION DESCRIPTION
**Wupatki National Monument**
Fourwing Saltbush / Alkali Sacaton Herbaceous Vegetation total vegetation cover ranged from 20 and 55% absolute cover with 10 and 26% in the shrub layer and 11 and 24% in the herbaceous layer. The total species diversity ranged from 7 and 12 species.

The shrub layer is dominated by *Atriplex canescens* with absolute cover of 9 and 18%. *Artemisia filifolia* can also occur with high cover (one relevé contained 8% absolute cover). The understory is dominated by *Sporobolus airoides* with 6-17% absolute cover.

**Globally**
The association is characterized by an open to moderately dense (10-50% cover) short-shrub layer dominated by *Atriplex canescens* with a perennial graminoid layer dominated by *Sporobolus airoides*. The shrub layer generally has greater cover than the herbaceous layer, and may include other scattered shrubs and dwarf-shrubs such as *Artemisia filifolia, Atriplex confertifolia, A. obovata, Chrysothamnus viscidiflorus, Ericameria nauseosa, Gutierrezia sarothrae, Isocoma pluriflora, Krascheninnikovia lanata, Lycium berlandieri, L. pallidum, Opuntia imbricata, O. leptocaulis, O. phaeacantha*, *Prosopis glandulosa*, and *Sarcobatus vermiculatus.* Associated herbaceous species such as *Elymus elymoides, Pascopyrum smithii, Pleuraphis jamesii, Sphaeralcea coccinea, Sporobolus cryptandrus, Sporobolus nealleyi,* and *Suaeda* spp. may be present. *Bouteloua gracilis* cover is minor and inconsistent (Francis 1986, Muldavin et al. 2000a, Shaw et al. 1989). Introduced species like *Salsola kali* or *Marrubium vulgare* may be common.

CONSERVATION RANK G5?

DATABASE CODE CEGL001291

MAP CLASSES
The association Fourwing Saltbush / Alkali Sacaton Herbaceous Vegetation was combined with other wash dependent associations into one map class, the Wupatki Wash System (map code 24).

Wupatki Wash System consists of these five association: *Artemisia filifolia – Ephedra (torreyana, viridis)* Shrubland, *Atriplex canescens / Sporobolus airoides* Shrubland, *Atriplex canescens* Desert Wash Shrubland (Provisional), *Fallugia paradoxa (Atriplex canescens – Ephedra torreyana)* Cinder Shrubland, and *Sporobolus airoides* Herbaceous Vegetation. Each of these associations may predominate the wash depending on different biotic and abiotic conditions.

The total area mapped of this map class within Wupatki NM is 1,384 ac (560 ha) within 182 polygons and the total area in the park environs is 939 ac (380 ha) within 123 polygons.

COMMENTS
**Globally**
Stands with relatively low cover of *Atriplex canescens* (10-25%) are included in this association because the shrub density is often variable within stands, but species composition and ecological processes do not change significantly. There are several similar associations that vary according to the abundance of different co-dominants, especially graminoids. Range-wide review of these types is needed to clarify their extent.

DYNAMICS
Both *Atriplex canescens* and *Sporobolus airoides* are widespread species in semi-arid and arid western North America. Both species are able to tolerate moderately high alkalinity or salinity and finer-textured soils with poor

drainage, but they are not restricted to these soils, and can be found growing on sand (USFS 1937). The shrub has an extensive root system and is very drought tolerant. It is very palatable and especially valuable winter forage, but can be severely damaged by over-utilization (USFS 1937). The bunchgrass produces abundant long-lived seeds that enable it to fully occupy and dominate favorable sites. It is deep-rooted and produces abundant coarse forage that is best utilized during the growing season (USFS 1937).

REFERENCES

Baker 1984, Bourgeron and Engelking 1994, Diamond 1993, Dick-Peddie 1986, Donart et al. 1978, Driscoll et al. 1984, Francis 1986, Muldavin et al 2000a, Shaw et al. 1989, U.S. Forest Service (USFS) 1937, Vest 1962

## *Atriplex canescens* Desert Wash Shrubland [Provisional]

| | |
|---|---|
| MAP CLASS | Wupatki Wash System, Fourwing Saltbush Upland Drainageways |
| COMMON NAME | Fourwing Saltbush Desert Wash Shrubland |
| PHYSIOGNOMIC CLASS | Shrubland (III) |
| PHYSIOGNOMIC SUBCLASS | Evergreen shrubland (III.A) |
| PHYSIOGNOMIC GROUP | Extremely xeromorphic evergreen shrubland (III.A.5) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (III.A.5.N) |
| FORMATION | Facultatively deciduous extremely xeromorphic subdesert shrubland (III.A.5.N.b) |
| ALLIANCE | *Atriplex canescens* Shrubland Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE

**Wupatki National Monument**

Fourwing Saltbush Desert Wash Shrubland is the most common association within the wash system at Wupatki NM. This association was only located from our relevé data within Wupatki NM; however, additional sampling may identify occurrences outside of the National Monument boundaries. Within Wupatki NM it was located in Citadel Wash, in the run off area south of Crack-in-rock Road, and in side washes near Wupatki Ruins.

ENVIRONMENTAL DESCRIPTION

**Wupatki National Monument**

Based on our four relevés, this association's elevation ranged from 4,429-4,856 ft (1,350-1,480 m) (average 4,636 ft/1,413 m) and occurred mainly on flat or gentle inclines from 3-10% (average 5.5%). This association occurs in washes with cinder and sandstone substrate.

MOST ABUNDANT SPECIES

**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Atriplex canescens* |

ASSOCIATED SPECIES

**Wupatki National Monument**

*Artemisia dracunculus, Artemisia filifolia, Ephedra torreyana, Ephedra viridis, Ericameria nauseosus, Gutierrezia sarothrae, Lycium andersoni, Muhlenbergia porteri, Sphaeralcea parvifolia, Sporobolus contractus, Stanleya pinnata*

VEGETATION DESCRIPTION

**Wupatki National Monument**

Fourwing Saltbush Desert Wash Shrubland total vegetation cover ranges from 14-25% (average 20%) with 15-24% (average 19%) absolute cover in the shrub layer and 1-7% (average 3%) absolute cover in the herbaceous layer. The total species diversity ranged from 7-17 species (average 13) within the 4 relevés sampled.

The shrub layer was dominated or co-dominated by *Atriplex canescens* with 4-16% absolute cover (average 8%). *Artemisia dracunculus* is often present in this wash association, with low to high cover 0-13% (average 4%). The herbaceous layer was low to sparse and not dominated by a single species.

CONSERVATION RANK G?

DATABASE CODE CEGL003470

MAP CLASSES
The association Fourwing Saltbush Desert Wash Shrubland is represented by map class Wupatki Wash System (map code 24) and Fourwing Saltbush Upland Drainageways (map code 18).

Wupatki Wash System consists of five associations: *Artemisia filifolia – Ephedra (torreyana, viridis)* Shrubland, *Atriplex canescens / Sporobolus airoides* Shrubland, *Atriplex canescens* Desert Wash Shrubland (Provisional), *Fallugia paradoxa (Atriplex canescens – Ephedra torreyana)* Cinder Shrubland, and *Sporobolus airoides* Herbaceous Vegetation. Each of these associations may predominate the wash depending on the site biotic and abiotic conditions.

The total area of Wupatki Wash System mapped within Wupatki NM is 1,384 ac (560 ha) within 182 polygons and the total area in the park environs is 939 ac (380 ha) within 123 polygons. The total area of Fourwing Saltbush Upland Drainageways mapped within Wupatki NM is 42 ac (17 ha) within 8 polygons and the total area in the park environs is 77 ac (31 ha) within 9 polygons.

**Note:**
This association is found in two different map classes:
1) Fourwing Saltbrush Upland Drainageways
2) Wupatki Wash System

## *Brickellia californica – Rhus trilobata* Shrubland

| | |
|---|---|
| MAP CLASS | Basalt Outcrop Shrubland |
| COMMON NAME | California Brickelbush – Skunkbush Sumac Shrubland |
| PHYSIOGNOMIC CLASS | Shrubland (III) |
| PHYSIOGNOMIC SUBCLASS | Deciduous shrubland (III.B) |
| PHYSIOGNOMIC GROUP | Cold-deciduous shrubland (III.B.2) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (III.B.2.N.a) |
| FORMATION | Temperate cold-deciduous shrubland (III.B.2.N.a) |
| ALLIANCE | *Brickellia californica* Shrubland Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE
**Wupatki National Monument**
California Brickelbush – Skunkbush Sumac Shrubland is an uncommon association that occurs mainly on small rock outcrops. This association was only located from our relevé data within Wupatki NM on two locations, specifically adjacent to Kana a Wash and in outcrops on and below Woodhouse Mesa.

ENVIRONMENTAL DESCRIPTION
**Wupatki National Monument**
Based on our three relevés, this association's elevation ranged from 4,593-5,184 ft (1,400-1,580 m) (average 4,957 ft/1,511 m), and occurs on flat or steep slopes from 0-34% (average 19%). This association occurs on rock outcrops and is associated with sandstone and remnant basaltic lava flows.

MOST ABUNDANT SPECIES
**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Brickellia californica, Rhus trilobata* |

ASSOCIATED SPECIES
**Wupatki National Monument**
*Andropogon hallii, Ephedra torreyana, Ericameria nauseosa, Eriogonum corymbosum, Fallugia paradoxa, Gutierrezia sarothrae, Hesperostipa comata, Pleuraphis jamesii*

VEGETATION DESCRIPTION
**Wupatki National Monument**
California Brickelbush – Skunkbush Sumac Shrubland total vegetation cover ranges from 25-27% (average 26%) with 18-24% (average 21%) absolute cover in the shrub layer and 1-7% (average 4%) absolute cover in the herbaceous layer. The total species diversity ranged from 11-16 species (average 13) within the 3 relevés sampled.

The shrub layer was dominated or co-dominated by *Brickellia californica* with 2-9% absolute cover (average 5%) and *Rhus trilobata* with 4-9% absolute cover (average 6%). *Ericameria nauseosa* may be present with high cover within this association with 1-7% absolute cover (average 4%). The herbaceous layer was low to sparse and not dominated by a single species.

CONSERVATION RANK G?

DATABASE CODE CEGL003493

MAP CLASSES
The association California Brickelbush – Skunkbush Sumac Shrubland is represented by map class Basalt Outcrop Shrubland (map code 2).

Basalt Outcrop Shrubland represents associations that are specific to basalt outcrops within Wupatki NM. Although this is the only association defined as occurring in this map class, other species and associations are likely to occur throughout this map class in the park and envrions.

The total area mapped within Wupatki NM is 59 ac (24 ha) within 78 polygons and the total area in the park environs is 237 ac (96 ha) within 249 polygons.

## *Ephedra torreyana – Achnatherum hymenoides* Hummock Shrubland

| | |
|---|---|
| MAP CLASS | Mormon Tea Cinder Dune Shrubland |
| COMMON NAME | Torrey's Joint-fir – Indian Ricegrass Hummock Shrubland |
| PHYSIOGNOMIC CLASS | Shrubland (III) |
| PHYSIOGNOMIC SUBCLASS | Evergreen shrubland (III.A) |
| PHYSIOGNOMIC GROUP | Extremely xeromorphic evergreen shrubland (III.A.5) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (III.A.5.N) |
| FORMATION | Broad-leaved and microphyllous evergreen extremely xeromorphic subdesert shrubland (III.A.5.N.a) |
| ALLIANCE | *Ephedra torreyana* Shrubland Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE
**Wupatki National Monument**
Torrey's Joint-fir – Indian Ricegrass Hummock Shrubland is an uncommon association that occurs specifically on cinder dunes in isolated areas within the park and the environs. Relevés were only located within Wupatki NM in the southeastern section of the park east of Peshlaki Springs.

ENVIRONMENTAL DESCRIPTION
**Wupatki National Monument**
Based on three relevés this association's elevation ranges from 4,839-4,872 ft (1,475-1,485 m) (average 4,856 ft/1,480 m) and it occurs on flat or low slopes from 0-5% (average 2%). This association occurs specifically on cinder dunes or hummocks with cinder substrate.

MOST ABUNDANT SPECIES
**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Ephedra torreyana* |
| Herbaceous | *Achnatherum hymenoides* |

ASSOCIATED SPECIES
**Wupatki National Monument**
*Aristida purpurea, Eriogonum corymbosum, Fallugia paradoxa, Pleuraphis jamesii*

VEGETATION DESCRIPTION
**Wupatki National Monument**
Torrey's Joint-fir – Indian Ricegrass Hummock Shrubland total vegetation cover ranges from 21-25% (average 24%) with 13-24% (average 18%) absolute cover in the shrub layer and 1-11% (average 6%) absolute cover in the herbaceous layer. The total species diversity ranges from 6-9 species (average 7) within the 3 relevés sampled.

The shrub layer was dominated by *Ephedra torreyana* (10% absolute cover in all relevés). However, *Fallugia paradoxa* had higher cover (12.5% absolute cover) in one relevé and may co-dominate in these areas. The herbaceous layer was low to moderate with *Achnatherum hymenoides* occurring in all relevés and acting as an indicator species for this association with 1-5% absolute cover (average 3%).

CONSERVATION RANK G?

DATABASE CODE CEGL005802

MAP CLASSES
The association Torrey's Joint-fir – Indian Ricegrass Hummock Shrubland is represented by map class Mormon Tea Cinder Dune Shrubland (map code 20).

The total area mapped within Wupatki NM is 343 ac (139 ha) within 17 polygons and the total area in the park environs is 744 ac (301 ha) within 59 polygons.

COMMENTS
**Wupatki National Monument**
The three representative relevés of this association were sampled in a limited area. Additional quantitative data of this association throughout its range may refine the species cover data.

## *Fallugia paradoxa – (Atriplex canescens – Ephedra torreyana)* Cinder Shrubland

| | |
|---|---|
| MAP CLASS | Apache Plume Cinder Shrubland, Wupatki Wash System |
| COMMON NAME | Apache Plume – (Fourwing Saltbush - Torrey's Joint-fir) Cinder Shrubland |
| PHYSIOGNOMIC CLASS | Shrubland (III) |
| PHYSIOGNOMIC SUBCLASS | Evergreen shrubland (III.A) |
| PHYSIOGNOMIC GROUP | Extremely xeromorphic evergreen shrubland (III.A.5) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (III.A.5.N) |
| FORMATION | Broad-leaved and microphyllous evergreen extremely xeromorphic subdesert shrubland (III.A.5.N.a) |
| ALLIANCE | *Fallugia paradoxa* Shrubland Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE
**Wupatki National Monument**
Apache Plume – (Fourwing Saltbush - Torrey's Joint-fir) Cinder Shrubland is a common association throughout Wupatki NM and the environs, often occurring in small areas within cinder substrate. This association was located in Wupatki NM specifically near Kana a Wash, Crack-in-rock Road, and on Doney Mountain. In the Forest Service lands, it was located east of Highway 89 adjacent to the Tuba City Road Tank.

ENVIRONMENTAL DESCRIPTION
**Wupatki National Monument**
Based on seventeen relevés, this association's elevation ranged from 4,462-6,070 ft (1,360-1,850m) (average 5,003 ft/1,525 m). It occurs on flat land to steep hillslopes from 0-48% slope (average 18%). This association sometimes occurs within washes or sheetflow areas. The association is found on red and black cinder.

MOST ABUNDANT SPECIES
**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Atriplex canescens, Ephedra torreyana, Fallugia paradoxa* |

ASSOCIATED SPECIES
**Wupatki National Monument**
*Artemisia dracunculus, Bouteloua eriopoda, Bouteloua gracilis, Brickellia oblongifolia, Ephedra viridis, Ericameria nauseosa, Gutierrezia sarothrae, Hesperostipa comata, Muhlenbergia porteri, Phacelia welshii, Pleuraphis jamesii, Tetraclea coulteri*

VEGETATION DESCRIPTION
**Wupatki National Monument**
Apache Plume – (Fourwing saltbush - Torrey's Joint-fir) Cinder Shrubland total vegetation cover ranges from 6-40% (average 20%) with 4-27% (average 16%) absolute cover in the shrub layer and 1-17% (average 5%) absolute cover in the herbaceous layer. The total species diversity ranged from 6-24 species (average 12) within the 17 relevés sampled.

The shrub layer is dominated by *Fallugia paradoxa* with 2-22% absolute cover (average 9%). *Atriplex canescens* and *Ephedra torreyana* are also often consistent species within this association; *Atriplex canescens* with 0-7% (average 2% absolute cover) and *Ephedra torreyana* with 0-9% (average 3% absolute cover). Other shrub species like *Ericameria nauseosa* may dominate this association as smaller patches within larger *Fallugia paradoxa* matrix. The herbaceous layer is low to moderate in cover with no consistent species.

CONSERVATION RANK G?

DATABASE CODE CEGL005806

MAP CLASSES
The association Apache Plume – (Fourwing Saltbush - Torrey's Joint-fir) Cinder Shrubland is represented by map class Apache Plume Cinder Shrubland (map code 21) and can also occur as a mosaic within the map class Wupatki Wash System (map code 24).

The Wupatki Wash System is a mosaic of associations that includes: *Sporobolus airoides* Herbaceous Vegetation, *Artemisia filifolia – Ephedra (torreyana, viridis)* Shrubland, *Atriplex canescens / Sporobolus airoides* Shrubland, *Atriplex canescens* Desert Wash Shrubland (Provisional), and *Fallugia paradoxa – (Atriplex canescens – Ephedra torreyana)* Cinder Shrubland.

The total area mapped within Wupatki NM is 2,471 ac (1,000 ha) within 576 polygons and the total area in the park environs is 2,414 ac (977 ha) within 374 polygons.

COMMENTS
**Wupatki National Monument**
Cinder substrate and the presence of *Fallugia paradoxa*, *Atriplex canescens*, or *Ephedra torreyana* are diagnostic for this association. Cover ranges from sparse to moderate. For sparse examples of this association, the diagnostic species may be widely spaced. *Fallugia paradoxa* is the most consistent species for this association.

**Note:**
This association is found in two different map classes:
1) Apache Plume Cinder Shrubland
2) Wupatki Wash System

## *Gutierrezia sarothrae* Dwarf-Shrubland Alliance

| | |
|---|---|
| MAP CLASS | Snakeweed/Galleta Grassland |
| COMMON NAME | Snakeweed Dwarf-Shrub Alliance |
| PHYSIOGNOMIC CLASS | Dwarf-shrubland (IV) |
| PHYSIOGNOMIC SUBCLASS | Deciduous dwarf-shrubland (IV.B) |
| PHYSIOGNOMIC GROUP | Cold-deciduous dwarf-shrubland (IV.B.2) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (IV.B.2.N.a) |
| FORMATION | Caespitose cold-deciduous dwarf-shrubland (IV.B.2.N.a) |
| ALLIANCE | *Gutierrezia sarothrae* Dwarf-shrubland Alliance |

CLASSIFICATION CONFIDENCE LEVEL Alliances are not ranked for confidence by NatureServe.

USFS WETLAND SYSTEM Upland

RANGE

**Wupatki National Monument**

Snakeweed Dwarf-Shrub Alliance was only identified in one location on the Navajo Nation. This relevé was found in a heavily grazed area northeast of Black Falls Crossing, adjacent to the Little Colorado River. More extensive sampling on the Navajo Nation may identify additional occurrences of this alliance; however, with a limited sample size we were not able to further assign this relevé to an association.

**Globally**

This alliance is reported from Utah and Arizona, but is likely more widespread throughout the semi-arid western U.S.

ENVIRONMENTAL DESCRIPTION

**Wupatki National Monument**

Based on the one observed relevé, this alliance was located on a flat surface at 4,298 ft (1,310 m) on sandy soils with cinder gravel intermixed.

**Globally**

This alliance is described from Utah and Arizona. Elevations range from 4,429-6,562 ft (1,350-2,000 m). Sites include stream terraces, plains, gently sloping hillslopes, ridges, plateaus and bluffs. Stands occur on all aspects. Soils are variable, but tend to be fine-textured and may occur over gravel and cobbles. Disturbance may be important in maintaining this vegetation community in some areas as some stands may have been created by chaining of trees and improper grazing by livestock.

MOST ABUNDANT SPECIES

**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Gutierrezia sarothrae* |

**Globally**

| Stratum | Species |
|---|---|
| Shrub | *Gutierrezia sarothrae* |

ASSOCIATED SPECIES

**Wupatki National Monument**

*Aristida purpurea, Achnatherum hymenoides, Ericameria nauseosa, Isocoma drummondii, Sporobolus airoides*

**Globally**

*Opuntia* spp, *Pinus edulis, Juniperus osteosperma, Achnatherum hymenoides, Aristida purpurea, Bouteloua gracilis, Elymus elymoides, Hesperostipa comata, Pascopyrum smithii, Pleuraphis jamesii*, *Sporobolus airoides*, *Chamaesyce* spp, *Sphaeralcea coccinea*, *Bromus tectorum, Salsola kali*

VEGETATION DESCRIPTION

**Wupatki National Monument**

Snakeweed Dwarf-Shrub Alliance's total vegetation cover was 27%, with 22% absolute cover in the shrub layer and 8% absolute cover in the herbaceous layer. Within the one relevé sampled the total species diversity was 10.

The shrub layer was dominated by *Gutierrezia sarothrae* with 15% absolute cover. The herbaceous layer was moderate with 4% absolute cover of both *Aristida purpurea* and *Sporobolus airoides*.

**Globally**

This broadly defined alliance is characterized by an open to moderately dense dwarf-shrub canopy (10-50% cover) dominated by *Gutierrezia sarothrae*, frequently with *Opuntia* spp. and a sparse to moderately dense herbaceous layer. Some stands have a diverse woody layer that includes low cover of *Artemisia nova, Atriplex canescens, Atriplex confertifolia, Atriplex obovata, Chrysothamnus viscidiflorus, Coleogyne ramosissima, Ephedra* spp., *Eriogonum* spp., *Grayia spinosa, Lycium pallidum, Parryella filifolia, Purshia tridentata, Yucca* spp., or occasional *Pinus edulis* or *Juniperus osteosperma* trees. The herbaceous layer is typically dominated by graminoids with several species present to abundant including *Pleuraphis jamesii, Achnatherum hymenoides, Aristida purpurea, Bouteloua gracilis, Elymus elymoides, Hesperostipa comata, Pascopyrum smithii*, or *Sporobolus airoides*. There is usually only sparse cover of native forbs like *Chamaesyce* spp. or *Sphaeralcea coccinea*; however, introduced species such as *Bromus tectorum, Erodium cicutarium, Sisymbrium altissimum*, or *Salsola kali* may dominate the herbaceous layer of some disturbed stands.

DATABASE CODE A.2528

MAP CLASSES

The alliance Snakeweed Dwarf-Shrub Alliance is represented by the map class Snakeweed/Galleta Grassland (map code 13).

The total area mapped within Wupatki NM is 237 ac (96 ha) within 60 polygons and the total area in the park environs is 662 ac (268 ha) within 131 polygons.

COMMENTS

**Wupatki National Monument**

Although only one relevé is assigned to this alliance, it is likely that with increased sampling, especially on the Navajo Nation, more relevés would be classified within this alliance. Increased sample size would allow for further refinement and classification of this alliance to the association level.

Although this relevé did occur on an anthropogenically disturbed site, other stands of *Gutierrezia sarothrae* are likely to occur in areas that have not been impacted by humans.

**Globally**

This broadly defined dwarf-shrubland alliance includes stands that could also be classified as a dwarf-shrub herbaceous vegetation.

REFERENCES

Stubbendieck et al. 1992, Cogan et al. 2004, USFS 1937, Von Loh 2000

## *Poliomintha incana / (Pleuraphis jamesii)* Shrubland

| | |
|---|---|
| MAP CLASS | Frosted Mint Shrubland |
| COMMON NAME | Hoary Rosemary-mint / (Galleta) Shrubland |
| PHYSIOGNOMIC CLASS | Shrubland (III) |
| PHYSIOGNOMIC SUBCLASS | Evergreen shrubland (III.A) |
| PHYSIOGNOMIC GROUP | Extremely xeromorphic evergreen shrubland (III.A.5) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (III.A.5.N) |
| FORMATION | Broad-leaved and microphyllous evergreen extremely xeromorphic subdesert shrubland (III.A.5.N.a) |
| ALLIANCE | *Poliomintha incana* Shrubland Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Upland

RANGE

**Wupatki National Monument**

Hoary Rosemary-mint / (Galleta) Shrubland is a common association occurring in the eastern section of the project boundary in sand dunes at Wupatki NM and the environs. This association was located from the relevé data on Wupatki NM south of Tse Lichii Point, west of the Little Colorado River, and north of Deadman's wash. On the USDA-FS it was located east Highway 89 adjacent to the Tuba City Road Tank and near Kish Zhini wash.

ENVIRONMENTAL DESCRIPTION

**Wupatki National Monument**

Based on six relevés, this association was found from low to high elevations, 4,236-6,178 ft (1,291-1,883 m) (average 4,364 ft/1,330 m). It occurs on flat land to steep slopes ranging from 0-27% (average 14%). This association occurs on sand dunes with sandy soils that can be intermixed with clay, riverine cobbles, and cinders.

MOST ABUNDANT SPECIES

**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Poliomintha incana* |
| Herbaceous | *Pleuraphis jamesii* |

ASSOCIATED SPECIES

**Wupatki National Monument**

*Achnatherum hymenoides, Alhagi maurorum, Artemisia filifolia, Atriplex canescens, Bouteloua eriopoda, Dasyochloa pulchella, Ephedra torreyana, Ericameria nauseosa, Gutierrezia sarothrae, Isocoma drummondii, Isocoma pluriflora, Parryella filifolia, Psorothamnus thompsoniae* var. *whitingii, Sporobolus airoides, Sporobolus flexuosus, Tiquilia latior, Yucca angustissima*

VEGETATION DESCRIPTION

**Wupatki National Monument**

Hoary Rosemary-mint / (Galleta) Shrubland total vegetation cover ranges from 10-45% (average 28%) with 9-22% (average 15%) absolute cover in the shrub layer and 2-30% (average 12%) absolute cover in the herbaceous layer. The total species diversity ranged from 11-21 species (average 15) within the 6 relevés sampled.

The indicator shrub for this association, *Poliomintha incana,* ranges from 2-6% absolute cover (average 3%). *Gutierrezia sarothrae* consistently occurred in our relevés and ranged in cover from 1-4% (average 2%). Dominant shrub species may include: *Artemisia filifolia, Ephedra torreyana, Isocoma pluriflora,* and *Psorothamnus thompsoniae* var. *whitingii.* The herbaceous layer's most consistent species is *Pleuraphis jamesii*; however, it was not present in all of our relevés and ranged in cover from 0-7% (average 2%).

CONSERVATION RANK G?

DATABASE CODE CEGL002930

MAP CLASSES
The association Hoary Rosemary-mint / (Galleta) Shrubland is represented by map class Frosted Mint Shrubland (map code 22).

The total area mapped within Wupatki NM is 220 ac (89 ha) within 8 polygons and the total area in the park environs is 10 ac (4 ha) within 1 polygon.

COMMENTS
**Wupatki National Monument**
*Poliomintha incana* is an indicator for Hoary Rosemary-mint / (Galleta) Shrubland at Wupatki NM; however, other shrubs may be dominant. The understory species, *Pleuraphis jamesii*, was selected as occurring most consistently within the relevés; however, other understory species may also dominate the association. The classification of this association may need to be reviewed with additional data.

## *Salix exigua* / Barren Shrubland

| | |
|---|---|
| MAP CLASS | Sandbar Willow Shrubland |
| COMMON NAME | Coyote Willow / Barren Shrubland |
| PHYSIOGNOMIC CLASS | Shrubland (III.) |
| PHYSIOGNOMIC SUBCLASS | Deciduous shrubland (III.B.) |
| PHYSIOGNOMIC GROUP | Cold-deciduous shrubland (III.B.2.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (III.B.2.N.) |
| FORMATION | Temporarily flooded cold-deciduous shrubland (III.B.2.N.d.) |
| ALLIANCE | *Salix (exigua, interior)* Temporarily Flooded Shrubland Alliance |

CLASSIFICATION CONFIDENCE LEVEL Strong

USFS WETLAND SYSTEM Palustrine

RANGE

**Wupatki National Monument**

Coyote Willow (sandbar willow) / Barren Shrubland has been only identified at Wupatki NM on the Little Colorado River. One relevé was identified on the east shore banks of the Little Colorado River, north of Black Falls Crossing. Only one small stand was sampled of this association, which may be due to *Tamarix* spp., a non-native invasive, possibly out-competing with the native *Salix exigua*. With more extensive sampling on the banks of the Little Colorado River more examples of this association may be revealed; however, it is likely that this association is diminishing within the project environs.

**Globally**

This riparian shrubland association is common at lower to middle elevations in the Great Basin, Colorado Plateau and Rocky Mountains extending out into the western Great Plains along major rivers.

ENVIRONMENTAL DESCRIPTION

**Wupatki National Monument**

This association was measured on the flat sandy riverbanks of the Little Colorado River at 4,268 ft (1,301 m).

**Globally**

This riparian shrubland is common in the Rocky Mountains, Colorado Plateau and Great Basin. Elevation ranges from 2,559-8,530 ft (780-2600 m). This association occurs within the annual flood zone of rivers on point bars, islands, sand or cobble bars, and on streambanks occurring along a wide variety of stream reaches, from moderately sinuous and moderate-gradient reaches. It can form large, wide stands on mid-channel islands in larger rivers or narrow stringer bands on small, rocky tributaries. Substrates are typically coarse alluvial deposits of sand, silt and cobbles that are highly stratified vertically from flooding scour and deposition, often consisting of alternating layers of finer textured soil with organic material over coarser alluvium. Occasionally, this association occurs on deep pockets of sand. The lack of soil development and high ground cover of coarse alluvial material are key indicators for this association.

MOST ABUNDANT SPECIES

**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Salix exigua* |

**Globally**

| Stratum | Species |
|---|---|
| Shrub | *Salix exigua* |

ASSOCIATED SPECIES

**Wupatki National Monument**

*Alhagi maurorum, Tamarix chinensis*

**Globally**
*Alnus incana, Salix monticola, Salix ligulifolia, Salix irrorata, Salix lucida, Acer negundo, Abies lasiocarpa, Populus angustifolia, Populus deltoides, Populus fremontii, Mentha arvensis*, *Carex* spp., *Eleocharis* spp., *Juncus* spp., *Schoenoplectus* spp., *Equisetum* spp.

VEGETATION DESCRIPTION
**Wupatki National Monument**
Coyote Willow / Barren Shrubland total vegetation cover was 71%, with 71% absolute cover in the shrub layer and no species in the herbaceous layer. Within the one relevé sampled the total species diversity was 7.

The shrub layer is dense and consists solely of *Salix exigua*. The herbaceous layer is barren with no species occurring in this layer, as is indicated in the association nomenclature.

**Globally**
This riparian association is characterized by a sparse to dense tall-shrub (1.5-3 m) canopy composed of *Salix exigua* with ground cover of exposed gravel, cobbles or sand. Relatively low cover of several other shrubs and trees may be present including *Alnus incana, Salix monticola, Salix ligulifolia (= Salix eriocephala* var. *ligulifolia), Salix irrorata, Salix lucida, Acer negundo, Abies lasiocarpa, Populus angustifolia, Populus deltoides*, and *Populus fremontii*. A sparse herbaceous layer may be present among the bare soil, gravel, cobbles, or boulders consisting of a wide variety of forbs and graminoids. *Mentha arvensis*, and species of *Carex, Eleocharis, Juncus, Schoenoplectus*, and *Equisetum* are often present. Introduced species, such as *Elaeagnus angustifolia, Tamarix* spp., *Bromus tectorum, Bromus inermis, Elymus repens (= Elytrigia repens), Poa pratensis, Agrostis stolonifera* (and other exotic forage species), *Taraxacum officinale, Conyza canadensis*, and *Lepidium latifolium*, have been reported from some stands.

CONSERVATION RANK G5

DATABASE CODE CEGL001200

MAP CLASSES
The association Coyote Willow / Barren Shrubland is represented by the map class Sandbar Willow Shrubland (map code 25).

The total area mapped within Wupatki NM is 3 ac (1 ha) within 5 polygons and the total area in the park environs is 20 ac (8 ha) within 28 polygons.

COMMENTS
**Wupatki National Monument**
The Little Colorado River riverbanks can alter significantly depending on the flooding regime, therefore it is likely that the riverbed has changed from when the photography was taken to when the field sampling was conducted. This map class is likely to change throughout time and should be reassessed annually to determine change in the riverbeds and the vegetation communities.

Only one relevé was assigned to this association, which may be due to a not enough relevés sampled on the Little Colorado River as well as small populations sizes within the project boundaries.

**Globally**
In the western Great Plains this association includes stands composed of intermediates between *Salix interior (= Salix exigua* ssp. *interior)* and *Salix exigua (= Salix exigua* ssp. *exigua)* (Dorn 1997, G. Kittel pers. comm. 2001). Until recently these taxa were combined at the species level (Kartesz 1999). More information on the distribution of introgression between *Salix interior (= Salix exigua* ssp. *interior)* and *Salix exigua (= Salix exigua* ssp. *exigua)* is needed to fully understand the ranges of these two species.

This association is an early-seral type that colonizes newly created point bars and other recent alluvial deposits formed in rivers and streams (Kittel et al. 1999). Competition with *Tamarix* spp. in the southwestern U.S. likely limit the abundance of this association where these introduced species dominate.

REFERENCES

Bourgeron and Engelking 1994, Christy 1973, Cowardin et al. 1979, Dorn 1997, Driscoll et al. 1984, Hall and Hansen 1997, Hansen et al. 1995, Johnston 1987, Jones and Walford 1995, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996, Kittel et al. 1999, Muldavin et al. 2000b, Padgett et al. 1988, Padgett et al. 1989, Tuhy and Jensen 1982, Von Loh et al. 2002

## *Tamarix* spp. Temporarily Flooded Shrubland

| | |
|---|---|
| MAP CLASS | Little Colorado River Invasive Riparian Shrubland |
| COMMON NAME | Saltcedar Temporarily Flooded Shrubland |
| PHYSIOGNOMIC CLASS | Shrubland (III.) |
| PHYSIOGNOMIC SUBCLASS | Microphyllous shrubland (III.A.4.N.c.) |
| PHYSIOGNOMIC GROUP | Temporarily flooded microphyllous shrubland (III.A.4.N.c.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural |
| FORMATION | Temporarily flooded microphyllous shrubland (III.A.4.N.c.) |
| ALLIANCE | *Tamarix* ssp. Semi-natural Temporarily Flooded Shrubland Alliance |

CLASSIFICATION CONFIDENCE LEVEL Moderate

USFS WETLAND SYSTEM Palustrine

RANGE

**Wupatki National Monument**

Saltcedar Temporarily Flooded Shrubland is the most common riparian association at Wupatki NM and the environs. This association is found from our relevé data to occur in major drainages with intermittent stream flow including the Little Colorado River and Deadman's Wash within Wupatki NM and the Navajo Nation.

**Globally**

This semi-natural shrubland is found along drainages in the semi-arid western Great Plains, interior and southwestern U.S. and northern Mexico, from central and eastern Montana, south to Colorado, western Oklahoma and Texas, west to California.

ENVIRONMENTAL DESCRIPTION

**Wupatki National Monument**

Based on six relevés, this association occurs on sandy riverbanks with low or no slopes (ranging 0-7%, average 1%) at elevations ranging from 3,960-4,364 ft (1,207-1,330 m) (average 4,199 ft/1,280 m).

**Globally**

These widespread shrublands are common along larger streams, rivers, and around playas in the western U.S. and Mexico. Elevation ranges from 246 ft (75 m) below sea level to 6,102 ft (1,860 m). *Tamarix* spp. have become naturalized in various sites including riverbanks, floodplains, basins, sandbars, side channels, springs, salt flats, and other saline habitats. Stands grow especially well along regulated rivers where flood-regenerated native species like *Populus* spp. are declining. Substrates are commonly thin sandy loam soil over alluvial deposits of sand, gravel or cobbles.

MOST ABUNDANT SPECIES

**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Shrub | *Tamarix* spp. |

**Globally**

| Stratum | Species |
|---|---|
| Shrub | *Tamarix ramosissima, T. chinensis, T. gallica*, or *T. parviflora* |

ASSOCIATED SPECIES

**Wupatki National Monument**

*Alhagi maurorum, Gutierrezia sarothrae, Isocoma pluriflora, Pascopyrum smithii, Salix exigua*

**Globally**

*Salix exigua, Prosopis* spp.*, Rhus trilobata*, and *Sarcobatus vermiculatus*

VEGETATION DESCRIPTION

**Wupatki National Monument**

Saltcedar Temporarily Flooded Shrubland total vegetation cover ranges from 14-90% (average 55%) with 12-90% (average 54%) absolute cover in the shrub layer and 0-8% (average 2%) absolute cover in the herbaceous layer. The total species diversity ranged from pure monocultures *Tamarix* spp. to a more diverse riparian biota with 1-12 species (average 6) within the 6 relevés sampled.

The shrub layer was dominated almost exclusively by *Tamarix* spp. with 6-95% absolute cover (average 49%). The herbaceous layer was low to moderate with no consistent species.

**Globally**

This semi-natural shrubland occurs along streams, rivers and playas where it forms a moderate to dense tall-shrub layer that is solely or strongly dominated by species of *Tamarix* including *T. ramosissima, T. chinensis, T. gallica*, and *T. parviflora*. Other shrubs may include species of *Salix* (especially *Salix exigua*) and *Prosopis, Rhus trilobata*, *Gutierrezia sarothrae, Isocoma pluriflora* and *Sarcobatus vermiculatus,* but with low cover (if shrub species are codominant then the stand is classified as a natural shrubland). Scattered *Acer negundo, Salix amygdaloides, Populus* spp., or *Elaeagnus angustifolia* trees may also be present. Depending on stand age and density of the shrub layer, an herbaceous layer may be present. Associated species include *Pascopyrum smithii*, *Distichlis spicata, Sporobolus airoides*, and introduced forage species such as *Agrostis gigantea, Agrostis stolonifera*, and *Poa pratensis*. Introduced herbaceous species such as *Polypogon monspeliensis, Conyza canadensis, Lepidium latifolium*, *Alhagi maurorum* and others have been reported from shrublands in this association.

CONSERVATION RANK GW

DATABASE CODE CEGL003114

MAP CLASSES

The association *Tamarix* spp. Temporarily Flooded Shrubland is represented by the map class Little Colorado River Invasive Riparian Shrubland (map code 26).

The map class Little Colorado River Invasive Riparian Shrubland also includes *Alhagi maurorum* Semi-natural Shrubland.

The total area mapped within Wupatki NM is 77 ac (31 ha) within 8 polygons and the total area in the park environs is 1,774 ac (718 ha) within 74 polygons.

COMMENTS

**Wupatki National Monument**

The Little Colorado River riverbanks can alter significantly depending on the flooding regime, therefore it is likely that the riverbed has changed from when the photography was taken to when the field sampling was conducted. This map class is likely to change throughout time and should be reassessed annually to determine change in the riverbeds and the vegetation communities.

It is characterized by dominance of the non-native invasive *Tamarix* spp. This shrub may be spreading and converting or degrading riparian associations characterized by native species. This vegetation association should be actively managed and monitored by park staff.

**Globally**

*Tamarix* spp. Temporarily Flooded Shrubland (CEGL003114) is a broadly defined plant association that is composed of many diverse *Tamarix* spp.-dominated vegetation communities from a wide variety of environments. Muldavin et al. (2000b) described 8 community types that will be reviewed as possible NVC associations.

*Tamarix* spp. are highly competitive shrubs that have invaded many riparian and wetland environments in the western U.S. Hansen et al. (1995) report that these shrubs are extremely drought- and salt-tolerant, produce prolific wind-dispersed seeds over much of the growing season, can resprout after burning or cutting, and if kept moist,

buried or broken branches will develop adventitious roots and grow. Stands seem to favor disturbed and flow-regulated rivers, but establish well in pristine areas, too. Under optimum conditions riparian areas can be converted to a dense thicket in less than 10 years (Hansen et al. 1995). Once established stands are extremely difficult to eradicate, requiring cutting with herbicide application on stumps to prevent resprouting (Smith 1989).

REFERENCES

Baalman 1965, Cowardin et al. 1979, Hansen et al. 1995, Hoagland 2000, Holland 1986, Muldavin et al. 2000b, Nachlinger and Reese 1996, Ortenberger and Bird 1933, Paysen et al. 1980, Sawyer and Keeler-Wolf 1995, Smith 1989, Stevens and Shannon 1917, Szaro 1989, Ungar 1968, Von Loh et al. 2002, Ware and Penfound 1949

## *Populus fremontii / Salix exigua* Forest

| | |
|---|---|
| MAP CLASS | Fremont Cottonwood Woodland |
| COMMON NAME | Fremont Cottonwood / Coyote Willow Forest |
| PHYSIOGNOMIC CLASS | Forest (I.) |
| PHYSIOGNOMIC SUBCLASS | Deciduous forest (I.B.) |
| PHYSIOGNOMIC GROUP | Cold-deciduous forest (I.B.2.) |
| PHYSIOGNOMIC SUBGROUP | Natural/Semi-natural (I.B.2.N.) |
| FORMATION | Temporarily flooded cold-deciduous forest (I.B.2.N.d.) |
| ALLIANCE | *Populus fremontii* Temporarily Flooded Forest Alliance |

CLASSIFICATION CONFIDENCE LEVEL Weak

USFS WETLAND SYSTEM Palustrine

RANGE

**Wupatki National Monument**

Fremont Cottonwood / Coyote Willow Forest has been identified in our relevé data from Wupatki NM only on the Little Colorado River. One relevé was found on the north shore banks of the Little Colorado River adjacent to Inscription Point. This small isolated stand of *Populus fremontii* may be a remnant association that is declining due to invasion of non-native *Tamarix* spp. With more extensive sampling on the riverbank of the Little Colorado River larger patches of this association may be identified; however, it is likely that this association is diminishing within the project boundary.

**Globally**

This riparian forest is known from southwestern New Mexico along the Gila River, the East Fork of the Virgin River in southwestern Utah, and in canyons in north-central Arizona. It likely occurs elsewhere in Utah and Arizona.

ENVIRONMENTAL DESCRIPTION

**Wupatki National Monument**

Based on one relevé, this association was located on the sandy riverbanks of the Little Colorado River at 4,249 ft (1,295 m).

**Globally**

This riparian forest association is documented from large rivers in southwestern Utah, southwestern New Mexico, and Arizona. Elevation ranges from 4,003-5,577 ft (1,220-1,700 m). Stands are found on stable bars in floodplains and along streambanks in canyons. Substrates are typically relatively recently deposited alluvium. Stream gradient is typically gentle, and soils are sandy (Muldavin et al. 2000b, Szaro 1989).

MOST ABUNDANT SPECIES

**Wupatki National Monument**

| Stratum | Species |
|---|---|
| Tree canopy | *Populus fremontii* |
| Shrub | *Salix exigua* |

**Globally**

| Stratum | Species |
|---|---|
| Tree canopy | *Populus fremontii* |
| Shrub | *Salix exigua* |
| Herbaceous | *Phragmites australis*, *Artemisia ludoviciana* |

ASSOCIATED SPECIES

**Wupatki National Monument**

*Alhagi maurorum, Tamarix chinensis*

**Globally**
*Acer negundo, Betula occidentalis, Ericameria nauseosa, Artemisia tridentata, Quercus gambelii, Distichlis spicata, Muhlenbergia asperifolia, Phragmites australis, Equisetum* spp.*, Juncus* spp.*, Carex* spp.

VEGETATION DESCRIPTION
**Wupatki National Monument**
Fremont Cottonwood / Coyote Willow Forest total vegetation cover was 40%, with 20% absolute cover in the shrub layer and 20% absolute cover the herbaceous layer. Within the one relevé sampled the total species diversity was 7.

*Salix exigua* is an indicator species in the shrub layer (7% absolute cover). *Tamari*x spp. has higher percent shrub cover (13% absolute cover); however, it is ubiquitous and non-native and is not representative of this native riparian vegetation association. The herbaceous layer had little cover with no dominant species.

**Globally**
This association is characterized by an open to dense deciduous tree canopy that is dominated by *Populus fremontii*, with *Salix exigua* dominating the tall-shrub layer. *Acer negundo* may be present in the tree canopy, but *Salix gooddingii* is typically not. *Baccharis salicifolia* is also typically not abundant in the shrub layer, but a variety of other riparian and upland shrub species may be present, including *Betula occidentalis*, *Ericameria nauseosa*, *Artemisia tridentata*, or *Quercus gambelii*. The herbaceous layer is generally sparse, depending on the density of the shrub and tree layers. *Distichlis spicata*, *Muhlenbergia asperifolia, Phragmites australis*, and species of *Equisetum*, *Juncus*, and *Carex* are commonly present (Muldavin et al. 2000b, Szaro 1989). Introduced species such as *Elaeagnus angustifolia, Tamarix* spp., *Alhagi maurorum, Melilotus* spp., *Bromus* spp., and *Poa pratensis* are often present in disturbed stands.

CONSERVATION RANK G?

DATABASE CODE CEGL000666

MAP CLASSES
The association Fremont Cottonwood / Coyote Willow Forest is represented by the map class Fremont Cottonwood Woodland (map code 28).

The total area mapped within Wupatki NM is 3 ac (1 ha) within 2 polygons and the total area in the park environs is 12 ac (5 ha) within 12 polygons.

COMMENTS
**Wupatki National Monument**
The Little Colorado River riverbanks can alter significantly depending on the flooding regime, therefore it is likely that the riverbed has changed from when the photography was taken to when the field sampling was conducted. This map class may be likely to change throughout time and should be reassessed for annual variability in the riverbeds and the vegetation communities.

This association should be assigned special park status to recognize and monitor change in the population throughout time. No *Populus fremontii* juveniles or seedlings were found in the relevé. This may indicate that this association is not recruiting on the banks of the Little Colorado River.

**Globally**
This association was not reported in the Handbook of Wetland Vegetation Communities of New Mexico (Muldavin et al. 2000b) and needs further review to distinguish from similar associations such as *Populus fremontii - Salix gooddingii / Salix exigua* Forest (CEGL002684). Part of the confusion is related to a taxonomic change in Rio Grande cottonwood from *Populus fremontii* var. *wislizeni* S. Wats. to *Populus deltoides* ssp. *wislizeni* (S. Wats.) Eckenwalder. This change resulted in part of this association (central NM along the Rio Grande) being moved into *Populus deltoides / Salix exigua* Woodland (CEGL002685). More work is needed to determine the range and possible areas of overlap between these two cottonwood species.

Few intact examples of this association remain in the Southwest U.S. It is documented from the Gila, middle Rio Grande and, possibly the lower Pecos rivers of southern New Mexico. It may also occur in southern Arizona. This association is found on stable bars at mid-elevations of the floodplain; it develops on recently deposited alluvium. Flood flows are required for the growth, maintenance and reproduction of this community type. The association continues to be in decline, primarily as a function of major hydrological alterations (dams and diversions), grazing, off-road vehicles and agricultural conversion. The remaining functional stands are restricted to wild rivers such as the Gila and San Francisco rivers, and possibly along the Mimbres River in New Mexico, or the San Pedro River in Arizona. It is a significant association with respect to biodiversity, particularly birds in the Southwest. Stands are rare that have not been invaded by exotic trees, shrubs and herbs. Even protected examples are threatened by continued declines in upland watershed conditions.

Periodic flooding is required for the growth, maintenance and reproduction of this forest.

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